



THE IMPERIAL ENCYCLOPEDIA AND DICTIONARY

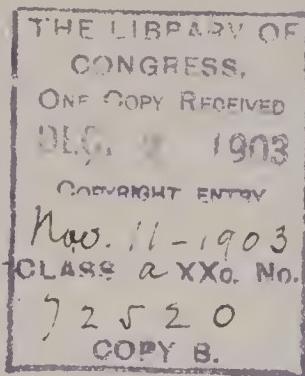
A LIBRARY OF UNIVERSAL
KNOWLEDGE AND AN UN-
ABRIDGED DICTIONARY OF
THE ENGLISH LANGUAGE
UNDER ONE ALPHABET

IN FORTY VOLUMES

VOLUME 13
ELECTRICITY—EXALBUMINOUS

NEW YORK HENRY G. ALLEN & COMPANY

A E 5
I 34



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BY

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SCHEME OF SOUND SYMBOLS FOR THE PRONUNCIATION OF WORDS.

Note.—(-) is the mark dividing words respelt phonetically into syllables; ('), the accent indicating on which syllable or syllables the accent or stress of the voice is to be placed.

Sound-sym- bols em- ployed in Respelling.	Representing the Sounds as exemplified in the Words.	Words respelt with Sound-symbols and Marks for Pronunciation.
ā	mate, fate, fail, aye	māt, fāt, fāl, ā.
ă	mat, fat	măt, făt.
â	far, calm, father	fâr, kâm, fâ'thér.
ä	care, fair	căr, fär.
aw	fall, laud, law	fawł, lawd, 'law.
ē	mete, meat, feet, free	mēt, mēt, fēt, frē.
ĕ	met, bed	mĕt, bĕd.
ē	her, stir, heard, cur	hér, stér, hérđ, kér.
î	pine, ply, height	pīn, plī, hīt.
ĭ	pin, nymph, ability	pīn, nīmf, ā-bil'ī-tī.
ō	note, toll, soul	nōt, tōl, sōl.
ŏ	not, plot	nōt, plōt.
ō	move, smooth	mōv, smōth.
ö	Goethe (similar to e in her)	gō'téh.
ow	noun, bough, cow	nown, bow, kow.
oy	boy, boil	boy, boyl.
ū	pure, dew, few	pūr, dū, fū.
ŭ	bud, come, tough	bûd, kûm, tûf.
ú	full, push, good	fûl, pûsh, gûd.
ü	French plume, Scotch guid	plûm, gûd.
ch	chair, match	chär, mäch.
ch	German buch, Heidelberg, Scotch loch (guttural)	bôch, hî'dél-bërch, lôch.
g	game, go, gun	gäm, gō, gün.
j	judge, gem, gin	jüß, jém, jín.
k	king, cat, cot, cut	king, kät, köt, küt.
s	sit, scene, cell, city, cypress	sít, sén, sél, sit'í, sî'prés.
sh	shun, ambition	shûn, ám-bish'ün.
th	thing, breath	thîng, brêth.
th	though, breathe	thô, brêth.
z	zeal, maze, muse	zél, máz, müz.
zh	azure, vision	ăzh'er, vîzh'ün.

ABBREVIATIONS USED IN THIS WORK.

a., or adj....adjective
A.B.....Bachelor of Arts
abbr.....abbreviation, abbreviated
abl. or abla.ablative
Abp.....Archbishop
abt.....about
Acad.....Academy
acc. or ac..accusative
accom.....accommodated, accommodation
act.....active
A.D.....in the year of our Lord [*Anno Domini*]
AdjtAdjutant
AdmAdmiral
adv. or ad..adverb
A. F.....Anglo-French
Ag.....Silver [*Argentum*]
agri.....agriculture
A. L.....Anglo-Latin
Al.....Aluminium
Ala.....Alabama
Alb.....Albanian
alg.....algebra
A.M.....before noon [*ante meridiem*]
A.M.....Master of Arts
Am.....Amos
Amer.....America, -n
anat.....anatomy, anatomical
anc.....ancient, anciently
AN. M.in the year of the world [*Anno Mundi*]
anon.....anonymous
antiq.....antiquity, antiquities
aor.....aorist, -ic
app.....appendix
appar.....apparently
Apr.....April
Ar.....Arabic
arch.....architecture
archæol....archæology
arith.....arithmetic
Ariz.....Arizona
Ark.....Arkansas
art.....article
artil.....artillery
AS.....Anglo-Saxon
As.....Arsenic
Assoc.....Association
asst.....assistant
astrol.....astrology
astron....astronomy
attrib.....attributive
atty.....attorney
at. wt.....atomic weight
Au.....Gold [*Aurum*]

A.U.C.....in the year of the building of the city (Rome)[*Annourbis conditæ*]
Aug.....August
aug.....augmentative
Aust.....Austrian
A. V.....authorized version [of Bible, 1611]
avoir.....avoirdupois
B.....Boron
B.....Britannic
b.....born
Ba.....Barium
Bart.....Baronet
Bav.....Bavarian
bl.; bbl....barrel; barrels
B.C.....before Christ
B.C.L....Bachelor of Civil Law
B.D.....Bachelor of Divinity
bef.....before
Belg.....Belgic
Beng.....Bengali
Bi.....Bismuth
biog.....biography,biograph- ical
biol.....biology
B.L.....Bachelor of Laws
Bohem.....Bohemian
bot.....botany, botanical
Bp.....Bishop
Br.....Bromine
Braz.....Brazilian
Bret.....Breton
Brig.....Brigadier
Brit.....British, Britannica
bro.....brother
Bulg.....Bulgarian
bush.....busbel, bushels
C.....Carbon
c.....century
Ca.....Calcium
Cal.....California
Camb.....Cambridge
Can.....Canada
Cant.....Canterbury
cap.....capital
Capt.....Captain
Card.....Cardinal
carp.....carpentry
Cath.....Catholic
caus.....causative
cav.....cavalry
Cd.....Cadmium
Ce.....Cerium
Celt.....Celtic
cent.....central
cf.....compare [*confer*]
ch or chh..church

ABBREVIATIONS.

Chal.	Chaldees	diff.	different, difference
chap.	chapter	dim.	diminutive
chem.	chemistry, chemical	dist.	district
Chin.	Chinese	distrib.	distributive
Chron.	Chronicles	div.	division
chron.	chronology	doz.	dozen
Cl.	Chlorine	Dr.	Doctor
Class.	Classical [= Greek and Latin]	dr.	dram, drams
Co.	Cobalt	dram.	dramatic
Co.	Company	Dut. or D.	Dutch
co.	county	dwt.	pennyweight
cog.	cognate [with]	dynam.	or
Col.	Colonel	dyn.	dynamics
Col.	Colossians	E.	Erbium
Coll.	College	E. or e.	East, -ern, -ward
colloq.	colloquial	E. or Eng.	English
Colo.	Colorado	Eccl.	Ecclesiastes
Com.	Commodore	eccl. or	{ ecclesiastical [af- eccles. { fairs]
com.	commerce, commer- cial	ed.	edited, edition, edi- tor
com.	common	e.g.	for example [ex gratia]
comp.	compare	E. Ind. or	{ East Indies, East
comp.	composition, com- pound	E. I.	} Indian
compar.	comparative	elect.	electricity
conch.	conchology	Emp.	Emperor
cong.	congress	Encyc.	Encyclopedia
Congl.	Congregational	Eng. or E.	English
conj.	conjunction	engin.	engineering
Conn or Ct.	Connecticut	entom.	entomology
contr.	contraction, con- tracted	env. ext.	envoy extraordinary
Cop.	Coptic	ep.	epistle
Cor.	Corinthians	Eph.	Ephesians
Corn.	Cornish	Episc.	Episcopal
corr.	corresponding	eq. or	= equal, equals
Cr.	Chromium	equiv.	equivalent
crystal.	crystallography	esp.	especially
Cs.	Cæsium	Est.	Esther
ct.	cent	estab.	established
Ct. or Conn.	Connecticut	Esthon.	Esthonian
Cu.	Copper [Cuprum]	etc.	and others like [et cetera]
cwt.	a hundred weight	Eth.	Ethiopic
Cyc.	Cyclopedia	ethnog.	ethnography
D.	Didymium	ethnol.	ethnology
D. or Dut.	Dutch	et seq.	and the following [et sequentia]
d.	died	etym.	etymology
d. [l. s. d.]	penny, pence	Eur.	European
Dan.	Daniel	Ex.	Exodus
Dan.	Danish	exclam.	exclamation
dat.	dative	Ezek.	Ezekiel
dau.	daughter	Ezr.	Ezra
D. C.	District of Columbia	F.	Fluorine
b.c.l.	Doctor of Civil [or Common] Law	F. or Fahr.	Fahrenheit
D.D.	Doctor of Divinity	f. or fem.	feminine
Dec.	December	F. or Fr.	French
dec.	declension	fa.	father
def.	definite, definition	Fahr. or F.	Fahrenheit
deg.	degree, degrees	far.	farriery
Del.	Delaware	Fe.	Iron [Ferrum]
del.	delegate, delegates	Feb.	February
dem.	democratic	fem or f.	feminine
dep.	deputy	fig.	figure, figuratively
dep.	deponent	Fin.	Finnish
dept.	department	F.—L.	French from Latin
deriv.	derivation, deriv- ative	Fla.	Florida
Deut.	Deuteronomy	Flem.	Flemish
dial.	dialect, dialectal	for.	foreign
diam.	diameter	fort.	fortification
Dic.	Dictionary	Fr. or F.	French
		fr.	from

ABBREVIATIONS.

freq.....	frequentative	ind.....	indicative
Fris.....	Frisian	indef.....	indefinite
ft.....	foot, feet	Indo-Eur...	Iudo-European
fut.....	future	inf.....	infantry
G. or Ger...	German	inf or infin.	infinitive
G.....	Glucinium	instr.....	instrument, -al
Ga.....	Gallium	int.....	interest
Ga.....	Georgia	intens.....	intensive
Gael.....	Gaelic	interj. or	
Gal.....	Galatians	int.....	interjection
gal.....	gallon	interrog....	interrogative
galv.....	galvanism, galvanic	noun	pro-
gard.....	gardening		
gen.....	gender	intr. or	
Gen.....	General	intrans...	intransitive
Gen.....	Genesis		
gen.....	genitive	Io.....	Iowa
Geno.....	Genoese	Ir.....	Iridium
geog.....	geography	Ir.....	Irish
geol.....	geology	Iran.....	Iranian
geom.....	geometry	irr.....	irregular, -ly
Ger.....	German, Germany	Is.....	Isaiah
Goth.....	Gothic	It.....	Italian
Gov.....	Governor	Jan.....	January
govt.....	government	Jap.....	Japanese
Gr.....	Grand, Great	Jas.....	James
Gr.....	Greek	Jer.....	Jeremiah
gr.....	grain, grains	Jn.....	John
gram.....	grammar	Josh.....	Joshua
Gr. Brit....	Great Britain	Jr.....	Junior
Gris.....	Grisons	Judg.....	Judges
gun.....	gunnery	K.....	Potassium [Kaliūm]
H.....	Hegira	K.....	Kings [in Bible]
H.....	Hydrogen	K.....	king
h.....	hour, hours	Kan.....	Kansas
Hab.....	Habakkuk	Kt.....	Knight
Hag.....	Haggai	Ky.....	Kentucky
H. B. M....	His [or Her] Britanic Majesty	L.....	Latin
Heb.....	Hebrew, Hebrews	L.....	Lithium
her.....	heraldry	l. [l. s. d.], { pound,	pounds
herpet.....	herpetology	or £.....} [sterling]	
Hg.....	Mercury [<i>Hydrargyrum</i>]	La.....	Lanthanum
hhd.....	hogshead, hogsheads	La.....	Louisiana
Hind.....	Hindustani, Hindu, or Hindi	Lam.....	Lamentations
hist.....	history, historical	Lang.....	Languedoc
Hon.....	Honorable	lang.....	language
hort.....	horticulture	Lap.....	Lapland
Hos.....	Hosea	lat.....	latitude
Hung.....	Hungarian	lb.; llb. or { pound ; pounds	
Hydros.....	Hydrostatics	lbs.....} [weight]	
I.....	Iodine	Let.....	Lettish
I.; Is.....	Island ; Islands	Lev.....	Leviticus
Icel.....	Icelandic	LG.....	Low German
ichth.....	ichthyology	L.H.D.....	Doctor of Polite Literature
Ida.....	Idaho	Lieut.....	Lieutenant
i.e.....	that is [<i>id est</i>]	Lim.....	Limousin
Ill.....	Illinois	Lin.....	Linnæus, Linnæan
illus.....	illustration	lit.....	literal, -ly
impera or		lit.....	literature
impr.....	imperative	Lith.....	Lithuanian
impers.....	impersonal	lithog.....	lithograph, -y
impf or imp	imperfect	LL.....	Late Latin, Low Latin
impf. p. or		LL.D.....	Doctor of Laws
imp.....	imperfect participle	long.....	longitude
improp.....	improperly	Luth.....	Lutheran
In.....	Indium	M.....	Middle
in.....	inch, inches	M.....	Monsieur
incept.....	inceptive	m.....	mile, miles
Ind.....	India, Indian	m. or masc.	masc. masculine
Ind.....	Indiana	M.A.....	Master of Arts

ABBREVIATIONS.

Maj.....	Major	N. A., or	
Mal.....	Malachi	N. Amer.	North America, -n
Mal.....	Malay, Malayan	nat.....	natural
manuf.....	manufacturing, manufacturers	naut.....	nautical
Mar.....	March	nav.....	navigation, naval af- fairs
masc or m.	masculine	Nb.....	Niobium
Mass.....	Massachusetts	N. C. or	
math.	mathematics, math- ematical	N. Car...	North Carolina
Matt.....	Matthew	N. D.....	North Dakota
M.D.....	Doctor of Medicine	Neb.....	Nebraska
MD.....	Middle Dutch	neg.....	negative
Md.....	Maryland	Neh.....	Nehemiah
ME.....	Middle English, or Old English	N. Eng....	New England
Me.....	Maine	neut or n...neuter	
mech.....	mechanics, mechani- cal	Nev.....	Nevada
med.....	medicine, medical	N. Gr.....	New Greek, Modern Greek
mem.....	member	N. H.....	New Hampshire
mensur....	mensuration	NHG.....	New High German [German]
Messrs. or		Ni.....	Nickel
MM.....	Gentlemen, Sirs	N. J.....	New Jersey
metal.....	metallurgy	NL.....	New Latin, Modern Latin
metaph....	metaphysics, meta- physical	N. Mex....	New Mexico
meteor....	meteorology	N. T. or	
Meth.....	Methodist	N. Test...	New Testament
Mex.....	Mexican	N. Y.....	New York [State]
Mg.....	Magnesium	nom.....	nominative
M. Gr.....	Middle Greek	Norm. F...	Norman French
MHG.....	Middle High German	North. E...	Northern English
Mic.....	Micah	Norw....	Norwegian, Norse
Mich.....	Michigan	Nov.....	November
mid.....	middle [voice]	Num.....	Numbers
Milan.....	Milanese	numis.....	numismatics
mid. L. or { Middle Latin, Me- ML..... } diaeval Latin		O.....	Ohio
milit. or		O.....	Old
mil....	military [affairs]	O.....	Oxygen
min.....	miuute, minutes	Obad.....	Obadiah
mineral....	mineralogy	obj.....	objective
Minu.....	Minnesota	obs. or †...	obsolete
Min. Plen...	Minister Plenipoten- tiary	obsoles....	obsolescent
Miss.....	Mississippi	O. Bulg....	Old Bulgarian or Old Slavic
ML. or { Middle Latin, Me- mid. L. ... } diaeval Latin		Oct.....	October
MLG.....	Middle Low German.	Odontog...	odontography
Mlle.....	Mademoiselle	OE.....	Old English
Mme.....	Madam	OF or	
Mn.....	Manganese	O. Fr....	Old French
Mo.....	Missouri	OHG.....	Old High German
Mo.....	Molybdenum	Ont.....	Ontario
mod.....	modern	opt.....	optics, optical
Mont.....	Montana	Or.....	Oregon
Mr.....	Master [Mister]	ord.....	order
Mrs.....	Mistress [Missis]	ord.....	ordnance
MS.; MSS..	manuscript; manu- scripts	org.....	organic
Mt.....	Mount, mountain	orig.....	original, -ly
mus.....	music	ornith.....	ornithology
MUS. DOC...	Doctor of Music	Os.....	Osmium
myth.....	mythology, mytho- logical	OS.	Old Saxon
N.....	Nitrogen	O. T., or	
N. or n....	North, -ern, -ward	O. Test...	Old Testament
n	noun	Oxf.....	Oxford
n or neut...	neuter	oz.....	ounce, ounces
Na	Sodium [<i>Natrium</i>]	P.....	Phosphorus
Nah.....	Nahum	p.; pp.....	page; pages
		p., or part..	participle
		Pa. or Penn.	Pennsylvania
		paint.....	painting
		palæon....	palæontology
		parl.....	parliament
		pass.....	passive

ABBREVIATIONS.

pathol or		
path	..... pathology	
Pb	..... Lead [<i>Plumbum</i>]	
Pd	..... Palladium	
Penn or Pa.	Pennsylvania	
perf	..... perfect	
perh	..... perhaps	
Pers	..... Persian, Persic	
pers	..... person	
persp	..... perspective	
pert	..... pertaining [to]	
Pet	..... Peter	
Pg. or Port.	Portuguese	
phiar	..... pharmacy	
PH.D	Doctor of Philoso- phy	
Phen	..... Phenician	
Phil	..... Philippians	
Philem	..... Philemon	
philol.	..... philology, philologi- cal	
philos.	{ philosophy, philo- or phil... } sophical	
phonog.	..... phonography	
photog.	..... photography	
phren	..... phrenology	
phys	..... physics, physical	
physiol	..... physiology, physi- ological	
Pied	..... Piedmontese	
Pl	..... Plate	
pl. or plu	.... plural	
Pl. D.	..... Platt Deutsch	
plupf	..... pluperfect	
P.M.	..... afternoon [<i>post meri- diem</i>]	
pneum	..... pneumatics	
P. O.	Post-office	
poet	..... poetical	
Pol	..... Polish	
pol econ	..... political economy	
polit	..... politics, political	
pop	..... population	
Port. or Pg.	Portuguese	
poss	..... possessive	
pp	..... pages	
pp	..... past participle, per- fect participle	
p. pr	..... present participle	
Pr. or Prov.	Provengal	
pref	..... prefix	
prep	..... preposition	
Pres	..... President	
pres	..... present	
Presb.	..... Presbyterian	
pret	..... preterit	
prim	..... primitive	
priv	..... privative	
prob	..... probably, probable	
Prof	Professor	
pron	..... pronoun	
pron	..... pronunciation, pro- nounced	
prop	..... properly	
pros	..... prosody	
Prot	..... Protestant	
Prov. or Pr.	Provengal	
Prov.	..... Proverbs	
prov	..... province, provincial	
Prov. Eng.	Provincial English	
Prus	..... Prussia, -n	
Ps.	..... Psalm, Psalms	
psychot	..... psychology	
pt	..... past tense	
pt	..... pint	
Pt	..... Platinum	
pub	..... published, publisher, publication	
pwt	..... pennyweight	
Q	..... Quebec	
qt	..... quart	
qtr	..... quarter [weight]	
qu	..... query	
q.v.	..... which see [<i>quod vide</i>]	
R	..... Rhodium	
R.	..... River	
Rb.	..... Rubidium	
R. Cath.	..... Roman Catholic	
rec. sec	..... recording secretary	
Ref.	..... Reformed	
refl.	..... reflex	
reg.	..... regular, -ly	
regt.	..... regiment	
rel. pro. or		
	..... relative pronoun	
repr	..... representing	
repub	..... republican	
Rev.	..... Revelation	
Rev.	..... The Reverend	
Rev. V.	..... Revised Version	
rhet	..... rhetoric, -al	
R. I.	..... Rhode Island	
R. N.	..... Royal Navy	
Rom	..... Roman, Romans	
Rom.	..... Romanic or Ro- mance	
Rom. Cath.	..... Roman Catholic	
Ch. or R.	{ Church	
C. Ch.		
r.r.	..... railroad	
Rt. Rev.	..... Right Reverend	
Ru	..... Ruthenium	
Russ	..... Russian	
r.w.	..... railway	
S.	..... Saxon	
S.	..... Sulphur	
s.	..... second, seconds	
s. [l. s. d.]	..... shilling, shillings	
S. or s.	..... South, -ern, -ward	
S. A. or		
	..... S. Amer. South America, -n	
Sam	..... Samaritan	
Sam	..... Samuel	
Sans, or		
	..... Sanskrit	
Sb.	..... Antimony [<i>Stibium</i>]	
s.c.	..... understand, supply, namely [<i>scilicet</i>]	
S. C. or		
	..... S. Car. South Carolina	
Scand.	..... Scandinavian	
Scot.	..... Scotland, Scotch	
scr.	..... scruple, scruples	
Scrip.	..... Scripture [s], Scrip- tural	
sculp.	..... sculpture	
S. D.	..... South Dakota	
Se.	..... Selenium	
sec.	..... secretary	
sec.	..... section	
Sem.	..... Semitic	
Sep.	..... September	
Serv.	..... Servian	
Shaks.	..... Shakespeare	
Si	..... Silicon	

ABBREVIATIONS.

Sic.....	Sicilian	trigon.....	trigonometry
sing.....	singular	Turk.....	Turkish
sis.....	sister	typog.....	typographical
Skr. or Sans.....	Sanskirt	U.....	Uranium
Slav.....	Slavonic, Slavic	ult.....	ultimate, -ly
Sn.....	Tin [Stannum]	Unit.....	Unitarian
Soc.....	Society	Univ.....	Universalist
Song Sol...	Song of Solomon	Univ.....	University
Sp.....	Spanish	U. Presb...	United Presbyterian
sp. gr.....	specific gravity	U. S....	United States
sq.....	square	U. S. A....	United States Army
Sr.....	Senior	U. S. N....	United States Navy
Sr.....	Strontium	Ut.....	Utah
St.: Ste....	Saint	V.....	Vanadium
St.	street	v.....	verb
stat.....	statute	Va.....	Virginia
S.T.D.....	Doctor of Sacred Theology	var.....	variant [word]
subj.....	subjunctive	var.....	variety of [species]
suf.....	suffix	Ven.....	Venerable
Su. Goth...	Suo-Gothic	Venet.....	Venetian
superl.....	superlative	vet.....	veterinary
Supp.....	Supplement	v. i. or v. intr....	verb intransitive
Supt	Superintendent	vil.....	village
surg.....	surgery, surgical	viz.....	namely, to-wit [<i>vide-</i> <i>licet</i>]
Surv.....	surveying	v. n.....	verb neuter
Sw.....	Swedish	voc.....	vocative
Swab.....	Swabian	vol.....	volume
sym.....	symbol	vols.....	volunteers
syn.....	synonym, -y	Vt.....	Vermont
Syr.....	Syriac, Syrian	v. tr.....	verb transitive
t	town	W.....	Tungsten [<i>Wolfram</i>]
Ta.....	Tantalum	W.....	Welsh
Tart.....	Tartar	W. or w....	West, -ern, -ward
Te.....	Tellurium	Wal.....	Walachian
technol ...	technology	Wall.....	Walloon
teleg.....	telegraphy	Wash.....	Washington
Tenn.....	Tennessee	Westph....	Westphalia, -n
term.....	termination	W. Ind. {	West Indies, West
terr.....	territory	or W. I. } Indian	
Teut.....	Teutonic	Wis.....	Wisconsin
Tex.....	Texas	wt.....	weight
Th.....	Thorium	W. Va.....	West Virginia
theat.....	theatrical	Wyo.....	Wyoming
theol.....	theology, theological	Y.....	Yttrium
therap.....	therapeutics	yd.....	yard
Thess.....	Thessalonians	yr.....	year
Ti.....	Titanium	Zech.....	Zechariah
Tim.....	Timothy	Zeph.....	Zephaniah
Tit.....	Titus	Zn.....	Zinc
Tl.....	Thallium	zool.....	zoology, zoological
toxicol....	toxicology	Zr.....	Zirconium
tp.....	township		
tr. or trans.	transitive		
transl.....	translation, trans- lated		

See also ABBREVIATIONS: in Vol. L

THE IMPERIAL CYCLOPEDIA AND DICTIONARY.

ELECTRICITY: term used in connection with an extensive and important class of natural phenomena, and denoting usually either the unknown cause of the phenomena or the science that treats of them.

Historical Sketch.—Thales, about B.C. 600, refers to the fact that amber (Gr. *élektron*), when rubbed, attracts light and dry bodies: see AMBER. This was the only electric fact known to the ancients. The science of E. dates properly from A.D. 1600, when Gilbert of Colchester, England, published a book, *De Arte Magnetica*, in which he gives a list of substances which he found to possess the same property as amber, and speculates on magnetic and electric forces. He is the inventor of the word electricity, which he derived from the Greek word *electron*, amber. Otto von Guericke, burgomaster of Magdeburg, in his work *Experimenta Nova Magdeburgica* (1672), describes, among his inventions, the first electric machine ever made, which consisted of a globe of sulphur turned by a handle, and rubbed by a cloth pressed against it by the hand. Hawksbee (1709) constructed a machine in which a glass cylinder, rubbed by the dry hand, replaced Guericke's sulphur globe. Grey and Wehler (1729) were the first to transmit electricity from one point to another, and to distinguish bodies into conductors and non-conductors. Dufay showed (1733-45) the identity of electrics and non conductors, and of non-electrics and conductors, and was the first to discover the two kinds of electricity, and the fundamental principle which regulates their action. Between 1733 and '44, much attention was given in Germany to the construction of electric machines. Till this time, notwithstanding the inventions of Guericke and Hawksbee, the glass tube rubbed by a piece of cloth which Gilbert first introduced, was used in all experiments. Boze, prof. at Wittenberg, taking the hint from Hawksbee's machine, employed a globe of glass for his machine, and furnished it with a prime conductor. Winkler, prof. at Leipzig, was the first to use a fixed cushion in the machine. The Leyden jar was (1746) discovered accidentally at Leyden by Muschenbroek; but the honor of the discovery has been contested in favor of Cuneus, a rich Burgess of that town, and of Kleist, canon of the cathedral of Camin, Pomerania. Franklin (1747) showed the electric conditions of the Ley-

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den jar, and (1752) proved the identity of lightning and electricity by his famous kite experiment. This last was performed with the same object about the same time, and quite independently, by Romas of the town of Nerac, France. In 1760, Franklin made the first lightning-conductor. Canton, Wilke, and Æpinus (1753-59), examined the nature of induction. Ramsden (1768) was the first to construct a plate-machine, and Nairn (1780) a two-fluid cylinder-machine. The electrophorus was invented by Volta 1775; and the condenser by the same electrician, 1782. In 1786 Galvani made the discovery which led to the addition of the new branch to the science which bears his name, and which now far exceeds the older branch in extent and practical value: see GALVANISM. In 1787, Coulomb, by means of his torsion-balance, investigated the laws of electric attraction and repulsion. In 1837, Faraday published the first of his researches on induction. Armstrong (1840) designed his hydro-electric machine.

In the article following, the aim is to present electric science as a unity, especially in relation to the modern doctrine of Energy: in this way only can justice be done to such important sub-divisions as Electrolysis and Thermo-electricity. It has been found convenient to omit Electro-kinetics and Electro-magnetism, as these are discussed best under MAGNETISM (q.v.). In the presentation of the facts and theories of what is commonly called Frictional Electricity or Electrostatics, the conceptions of Faraday, as interpreted and extended by Thomson and Maxwell, are closely followed. In no case is the ordinary two-fluid theory explicitly used; though it is impossible to escape altogether from its implication in the nomenclature which has survived the theory that gave it birth. The history of the science is treated incidentally in outline.

The following is an epitome of the arrangement. Electrostatics takes up nearly half the article, and is followed by Electro-kinematics, Electrolysis, and Thermo-electricity in order, thus:

- Electrification,
- Electroscope, electrometer,
- Fundamental experiments,
- Potential; equipotential surfaces, lines of force,
- Capacity; concentric spheres, parallel planes,
- Absolute measurement of electric quantities,
- Specific inductive capacity,
- Instruments for generating electricity,
- Loss of energy at discharge,
- Transference of charge, current,
- Galvanometer,
- Electromotive force,
- Resistance, Ohm's Law,
- Joule's Law,
- Electrolysis,
- Energy relations of voltaic cells,
- Conduction and discharge compared,
- Secondary batteries,
- Reversible thermal effects of currents,
- Thermo-electricity.

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If a stick of sealing-wax is rubbed vigorously with woolen cloth, it will be found capable of attracting small shreds of paper: this is the simplest experiment in electricity. Many other substances, e.g., resin, vulcanite, glass, etc., can be made to show the same phenomenon. To obtain the best effect with any given substance, a particular rubber must be chosen.. For example, a cat's fur, slightly warmed, is very efficient in electrifying vulcanite or resin; while silk, among simple substances, should be used to excite glass. It is now known, however, that any two different substances which can be rubbed together become electrified by the friction. Thus, if wax and glass are rubbed together, they both will become electrified—i.e., capable of attracting light objects. And so, in the other instances, it can be shown by experiment that the cloth is electrified as well as the wax, the cat's fur as well as the vulcanite, the silk as well as the glass. Moreover, the two substances so electrified by mutual rubbing are found to attract one another, being indeed *oppositely* electrified—a term which the following experiment will elucidate:

Let two pieces of glass be electrified by rubbing each with a distinct piece of resin. The pieces of resin also will be electrified, and it will be found (1) that the pieces of glass repel each other; (2) that the pieces of resin repel each other; (3) that each piece of glass attracts each piece of resin. Exactly the same phenomena of attraction and repulsion will be shown—only much more powerfully, because of the greater efficiency of the rubbing—if the pieces of resin are rubbed with cat's fur and the pieces of glass with silk.

Again, let a small light body, e.g., a pith-ball, be suspended at the end of a silk thread. This will be attracted by either the resin or the glass. But if it is allowed to come into contact with, say, the resin, it will immediately be repelled by the resin and strongly attracted by the glass. And if it should be allowed to touch the glass, it will at once be repelled by the glass and strongly attracted by the resin. By such contact the pith-ball itself becomes electrified; for it will repel a second pith-ball similarly treated. We are thus led to the following conclusions: Repulsion exists between bodies which are similarly electrified, and attraction between bodies which are oppositely electrified. Bodies electrified by mutual rubbing become oppositely electrified. A body electrified by contact with an electrified body becomes electrified similarly to that body. Substances which, like silk-rubbed glass, repel silk-rubbed glass and attract wool-rubbed resin, are vitreously or *positively* electrified, while bodies which attract silk-rubbed glass and repel wool-rubbed resin are resinously or *negatively* electrified. The indication of the two kinds of electrification by opposite signs is very appropriate, but the application of the positive sign to one rather than to the other is a matter of convention and purely arbitrary.

To study electrical phenomena by means of metallic substances, it is necessary first of all to *insulate* them—i.e., to support them on glass, vulcanite, paraffin, etc., or to hang

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them by silk threads. The significance of the term *insulation* will appear from the following experiment: Hang two metal balls, one by a silk thread and the other by a wire, and touch them with a piece of wax strongly electrified by friction. On trial, the silk-suspended ball will be found electrified; but not so the wire-suspended ball. Or, again, set a metal ball on a glass support, but let a wire connect it with the table or the hand. It will be found impossible to electrify it by contact with an electrified body. But remove the connecting wire, and immediately a single contact will suffice to electrify the ball. Thus we recognize two kinds of substances—viz., *insulators* and *non-insulators*. The latter are usually called *conductors*, and include all ordinary metals. Such conductors can be electrified only when insulated.

When a body is sufficiently strongly electrified and brought very near another body originally unelectrified, a spark will pass between them even before they are made to touch. If this second body is the finger or knuckle, the spark will be accompanied by a peculiar sensation called an electric shock. Now let us take such a highly electrified conductor A, and bring near to it a second insulated conductor B, but not so near as to cause a spark to pass. If, then, the finger be brought near enough to B, a shock will be felt, a spark will pass between B and the finger, though B was originally not electrified. Thus B has become electrified by being brought into the neighborhood of A. This mode of electrification is called electrification by *induction*. As Faraday clearly pointed out, it ‘has the character of a first, essential, and fundamental principle,’ and its thorough comprehension is of prime importance.

As it is our purpose to regard the whole subject from the Faraday point of view, it will be convenient to define certain useful terms. The *electric field* is any region of air, glass, vulcanite, or other non-conducting substance surrounding or containing electrified bodies. In it and through it, the electric forces act; hence it is convenient to call such insulating substances *dielectrics*, especially when attention is being drawn to the rôle that they play as transmitters of electric action. To investigate the properties of an electric field, it is generally necessary to bring into it a conductor, as in the experiment above described. In that experiment the induced electrical condition of B was studied by means of a physiological sensation, partly optical, partly muscular. A far better way, however, of studying the phenomena of induction is to make use of the fundamental laws of attraction and repulsion between electrified bodies, as they are mechanically applied in such instruments as the gold-leaf electroscope, Coulomb’s torsion balance, Thomson’s quadrant electrometer, etc.

In the gold-leaf electroscope (invented by Bennet 1787),

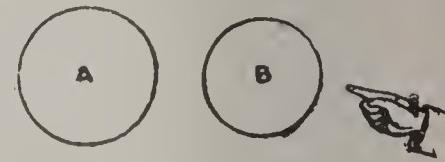


Fig. 1.

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two light strips of gold-leaf hang from the lower end of a metal rod, which passes vertically through an opening in the top of a glass bottle and expands above into a plate. If

a piece of rubbed sealing-wax or other electrified body be brought near the plate, the gold leaves will repel each other and diverge. In other words, the conductor, consisting of the plate, rod, and gold leaves, has been introduced into an electric field, and has in consequence become electrified by induction. This is shown by the repulsion between the similarly electrified gold leaves. The nearer the electrified body is brought, the stronger is the electric field surrounding the electroscope, the wider do the gold leaves diverge. Here evidently the repulsion tends to lift the centre of gravity of each gold leaf, and is finally balanced by the action of gravity. A cylinder of wire gauze, placed just inside the glass case, improves the action of the instrument. The other two instruments mentioned above depend for their action on the same general principle—the equilibrium of a body under the action of the electrical and what, for distinction, might be called the material forces.

Coulomb's torsion balance is historically the first true electrometer—i.e., the first instrument whose indications were capable of quantitative interpretation. In it the force with which one small charged sphere is repelled by another similarly charged is balanced by the torsion of a wire, which acts as suspension to a horizontal insulating rod bearing the one sphere at one of its ends. By rotation of the upper end of the wire this sphere can be made to move in a horizontal circle; and at some point in the circumference of the circle the other sphere is fixed. If the spheres are charged, the rod bearing the movable sphere will take a position of equilibrium under the combined action of the electrical force and the torsion of the suspension; and these, as regards their rotatory effect on the rod, must be equal. But by the laws of elasticity, the force of torsion is proportional to the twist of the wire, and the twist itself is as easily measured as the distance between the spheres. Hence to the degree of accuracy to which the geometrical configuration of the system is known, the electric force can be calculated in terms of the elastic constants of the wire. In this way Coulomb proved, 1785, that two small charged balls repelled each other with a force which diminished as the square of the distance increased.

Sir William Thomson's quadrant electrometer is, in a certain sense, a development of Coulomb's torsion balance. Its many nice electrical and mechanical devices render it a peculiarly delicate and accurate instrument for measuring



Fig. 2.

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minute differences in electrification. Essentially it consists of four hollow brass quadrants, which when fitted close together form a squat hollow cylinder bounded above and below by parallel plane faces. For electrical purposes they must, however, be drawn a little apart, so that when looked at from above or from below they have the appearance as shown in the figure—viz., that of a circular disk with two mutually perpendicular diametral clefts. Each quadrant is insulated on its own glass support; but each is joined to its opposite by a wire, so that electrically they go in pairs. From one of each pair a vertical rod leads to the outside of the case in which the whole is inclosed. These rods are called the *electrodes*, and their function is to bring the pairs of quadrants into electrical connection with external bodies. The inside corner of the top and bottom of each quadrant is cut away, so that at the centre a small circular space is left concentric with the external cylindrical surface of the quadrants. In the hollow space inclosed by the quadrants, a light charged body (*E* in fig. 3, *u* in fig. 4) of convenient shape hangs, its axis of suspension passing up through the circular central space just mentioned. The light body can rotate about this vertical axis only, and its motion is controlled by the torsion of the suspension. If the four quadrants all are connected together, the suspension makes the light body hang so as to lie with its longer axis of symmetry parallel to one of the diametral clefts separating the quadrants. If, however, the pairs of quadrants are disconnected, and by connection with external bodies brought into different electric conditions, electrical forces will at once act on the charged body and rotate it until they are balanced by the resisting torsion of the suspension. Thus let the charged body *u* (fig. 4) be charged positively; and let the pairs of quadrants be charged differently, so that the ones marked *AA'* have a higher positive charge than the ones marked *BB'*. Then the charged body will move so as to come more within the quadrants *BB'*. If the relative electrifications of the pairs of quadrants is reversed, the charged body will move the other way. The motion is shown and measured by means of a beam of light reflected from a small mirror fixed to the vertical axis of suspension of the body and moving with it.

Henceforth we shall use the unqualified words electro-

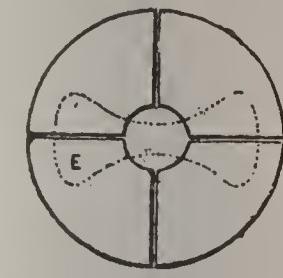


Fig. 3.

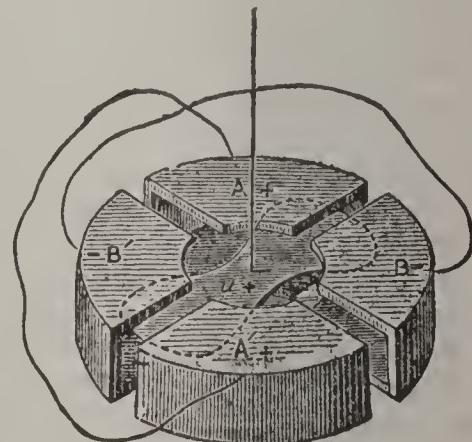


Fig. 4.

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scope and electrometer as meaning the gold-leaf electro-scope and quadrant electrometer respectively.

We are now in a position to make an accurate study of the phenomena of induction. We shall suppose, when nothing is said to the contrary, that all our conductors are of one metal, say brass; that they are at the beginning of every experiment insulated and unelectrified; that the electroscope and electrometer quadrants are likewise un-electrified at the beginning of each experiment; and that the dielectric is air.

Experiment I.—Set a cylindrical brass vessel on the electro-scope; and let down into it, without coming into contact with it, a positively charged conductor A. It is convenient to hang this charged ball at the end of a short silk thread from the lid of the vessel, the lid itself being lowered or raised by means of a silk thread. As soon as the ball is brought inside the vessel, the gold leaves will diverge, as shown in fig. 5; and the vessel B, as regards outside objects, will behave as if positively electrified. Now touch B with the hand or with any non-insulating material connected to earth—in technical language, put the vessel to earth—and the gold leaves will fall together, and all appearance of electrification will be destroyed. Remove the earth connection so as to insulate B once more, and lift away the lid and the attached ball, care being taken to prevent A coming in contact with B. The gold leaves will again diverge, and the vessel B will be found to be negatively electrified.

The nature of the charge on the vessel and gold leaves is indicated at once by the approach of an electrified body. If a piece of rubbed sealing-wax or any negatively charged body is brought near, the gold leaves, if negatively electrified, will diverge still more; if positively electrified, will tend to fall together.

In thus charging the vessel B negatively by induction, we have in no way diminished the original positive charge on A : and we may use this same charge an indefinite number of times in charging negatively other bodies like B. No doubt in each body so charged by induction we have a new-formed source of energy; but this has been derived, not from the energy spent in originally charging the ball, but from the energy spent in separating against their mutual attraction the positively charged ball and the negatively charged vessel.

Experiment II.—Begin again as in Experiment I., introducing the charged ball A into B, and putting B to earth, so that the gold leaves fall together. Now connect A with B. No effect will be observed on the electro-scope, even though, as in the former experiment, A should be removed. Thus the charge on A has been completely destroyed; hence, there must have been on B, just before the contact was made, an equal but opposite charge. This

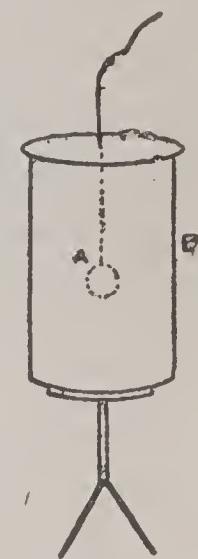


Fig. 5.

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is, in fact, the very charge which made its presence evident when, in Experiment I., the ball A was removed.

Thus, if a charged body A be completely surrounded by a closed vessel B, which is put to earth and then insulated, the charge induced on B is equal and opposite to the charge on A. To make this induced charge apparent, we must remove A.

Experiment III.—Repeat Experiment I., and after having charged B negatively by induction, introduce A into another conductor C, initially without charge and insulated. If C is resting on a gold-leaf electroscope, the gold leaves will diverge with positive electrification, as in the earlier stage of Experiment I. Bring now A into metallic connection with C. If C *completely* surrounds A, no change will be observed on the electroscope, although a spark may be heard at the instant the contact is made. The ball A, if removed without again coming in contact with C, will be found to have lost all its charge; and if B and C are brought into metallic connection, all appearance of electrification on them also will be destroyed. In other words, the negative charge induced on B has been quite destroyed by union with the positive charge transferred to C. These charges therefore must be equal and opposite. Thus, the charge originally on A has been wholly transferred to C.

We conclude, then, that when a conductor is electrified, its electrification resides wholly on the surface. Any portion of it removed from the inside will be found unelectrified if taken quite out of the influence of other electrified bodies.

This experiment, or one very similar to it, was first performed 1772 by Henry Cavendish, who deduced from it by rigorous mathematical reasoning that ‘electric attraction and repulsion must be inversely as the square of the distance.’ He inclosed a metal globe within a hollow conducting shell built up of two hemispheres. The globe and shell were connected by a wire and charged. The globe was then disconnected from the shell, and immediately thereafter the hemispheres forming the shell were drawn asunder. The globe, now left exposed, was tested for electrification; and, to the degree of accuracy of the experiment, none was found.

Maxwell repeated the experiment in a much more delicate manner than was possible before the invention of the quadrant electrometer. During the charging of the shell and inclosed globe, these were connected by a short wire ‘fastened to a small metal disk hinged to the shell, and acting as a lid to a small hole in it.’ After the charging, this lid was lifted up by means of a silk thread, and the communication between the shell and the globe done away with. The shell was then discharged and kept connected to earth. Through the small hole in the shell, a wire was led, connecting the globe with one electrode of the quadrant electrometer. Not the slightest deflection could be observed.

It is impossible, then, to charge a body by placing it inside a charged conductor. In other words, there is no electric field within any region bounded by a conducting surface,

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however much that surface may itself be charged, unless there be within that region other insulated and independently charged bodies. It matters not what electrical phenomena may be taking place in the region outside such a conducting surface, such external electrical phenomena have absolutely no internal electrical effect ; and *vice versa*, any purely internal electrical change can produce no external electric effect. In short, any closed conducting surface divides space into two regions, electrically independent the one of the other—i.e., so far as electrical action through either is concerned. This principle is taken advantage of in the construction of the quadrant electrometer, the essential internal arrangements of the instrument being inclosed as far as possible within a conducting vessel, the quadrants communicating with external space only by means of their electrodes.

Experiment IV.—The conclusions above stated may be easily illustrated by use of the quadrant electrometer. Thus, as in Experiment I., let the positively charged body A be introduced into an insulated and initially unelectrified closed conductor B. Then, as we know, B becomes electrified, and the region round B becomes an electric field. The condition of this electric field may be studied by means of a small sphere C, joined by a long thin wire to one electrode —i.e., to one pair of quadrants—of the electrometer E. The other electrode is supposed to be kept connected to earth. Before A was introduced into B, the electrometer showed no sign of electrification. But as soon as A is introduced into B, C and its connected quadrants become electrified. The deflection produced on the electrometer will depend on the position of C with regard to B and on the original charge of A. It is quite independent, however, of the particular position of A, which may be moved about inside B without in any way affecting the deflection on the electrometer. A may even be brought into contact with B (as in Experiment III.) so as completely to lose its charge ; and yet the electrification of C, as shown on the electrometer, is

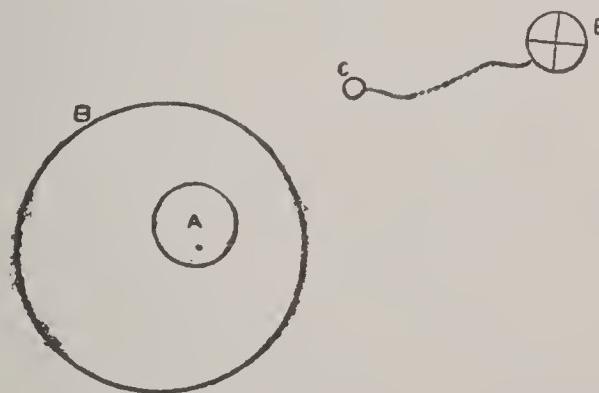


Fig. 6.

in no way altered—in other words, the electric field outside B is independent altogether of any purely internal changes which may take place inside B.

Suppose, now, that when A has been introduced into B, and a corresponding deflection obtained on the electrometer, B is put to earth. At once the electric field around B is

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destroyed, C and its connected quadrants recover their original unelectrified condition, and the electrometer gives zero deflection on its scale. Thus the charge on A is completely masked by being surrounded by a closed conductor put to earth.

Further, let B be insulated again and A removed with its charge—then, as we already know, B will be left negatively electrified. The region round B will again become an electric field, and C and its connected quadrants once more electrified. But the deflection on the electrometer, though equal to that first obtained, will be in the opposite direction, opposite because of the opposite character of B's electrification.

This experiment may be taken as an illustration of one of the most fundamental facts in electrostatics—viz., that the generation of so much positive electrification implies the generation of as much negative electrification. Here is a conductor B apparently without charge. Remove from it by any process a positive charge, and an equal negative charge is left behind. The same is true when bodies are electrified by friction, as may be proved by operating inside a closed insulated conductor joined to one electrode of the electrometer. The most energetic rubbing of the two bodies, and their subsequent separation, each in a highly electrified condition, produce no effect whatever on the electrometer—thus showing that their inductive effects on the inclosing conductor are equal and opposite—i.e., their charges are equal and opposite.

Experiment V.—To study in greater detail the properties of the electric field around a given charged conductor B, take two small insulated spheres and connect them by thin wires to the electrodes of the electrometer, each to one. Suppose these spheres to be at first in close contact at some part of the field; then, since the pairs of quadrants are in the same electrical condition, the electrometer will show zero deflection. Now gently separate the spheres, both insulated, of course, and in general a deflection to the right or to the left will be obtained on the electrometer. By trial we may find the unique direction of separation which, for a given distance of separation, gives the maximum deflection. This will be to the right or to the left, according to the relative position of the two spheres. It will be found, however, that a separation of the spheres in directions at right angles to this unique direction does not cause any deflection on the electrometer. It is far easier indeed to find these directions of separation for which there is no deflection than to find the direction of maximum deflection for a given separation. Suppose in fact that the one small sphere is fixed in position, and that the other, which we may call the exploring sphere, is moved away from contact with it in such a manner that the electrometer always shows zero deflection. The centre of the exploring sphere will describe a curve, and can be made by successive trials to describe an infinity of curves, all lying on a certain surface which passes through the centre of the fixed sphere. We shall call this the surface S. Now with the exploring

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sphere lying anywhere on this surface, let the fixed sphere

be shifted in toward B till the electrometer deflection is unity. Then shift the exploring sphere correspondingly until the deflection is brought back to zero again, and proceed as in the first position to trace out a second surface, which we shall call

$S + 1$, and which will pass through the centre of the fixed sphere in its second position. Shift the fixed sphere once more till unit deflection is obtained, follow up with the exploring sphere, and trace out the third surface $S + 2$. In this way, step by step, the electric field may be supposed to be mapped out by a series of surfaces, differing in value by unity as measured on the electrometer scale. We may pass out to the surfaces $S - 1$, $S - 2$, $S - 3$, etc., as well as in to the surfaces $S + 1$, $S + 2$, $S + 3$, etc. These surfaces are all closed, and cannot cut each other. For suppose two did cut each other ; then, by putting the fixed sphere in the supposed line of intersection, we could move the exploring sphere from the position S to the position $S + 1$, and produce no change on the electrometer ; which is a manifest absurdity, as $S + 1$ is defined in terms of S and a change. If the electrodes of the electrometer terminate on any one of these surfaces, there is no deflection ; if they terminate on different surfaces, the deflection is the difference of the name-values of the surfaces. Evidently the conductor B is such a surface, for if the electrodes terminate on it, all the quadrants, being in metallic connection, will be in the same electrical condition, and the electrometer will show no deflection.

The surfaces we have just described are called *equipotential* surfaces, the term potential having in electricity much the same import as temperature has in heat or pressure in hydrodynamics. When a channel exists between two masses of fluid at different pressures, fluid will flow from where the pressure is higher to where it is lower. Similarly if we have two charged conductors whose electrical conditions as tested by electroscope or electrometer become changed after they have been connected by a wire and disconnected again, these two conductors are said to have been at first at different potentials. If they had been connected to the electrodes of the electrometer, each to one, the electrometer would have shown a deflection ; and this deflection would have been a measure of the difference of potential. If the difference of potential is great, then the contact of the two conductors is evidenced by an obvious electrical discharge in the form of a visible audible spark.

If we directed our attention to conductors only, we should not find any special advantage in using the phrase ‘difference of potential’ instead of ‘differently electrified’ ;

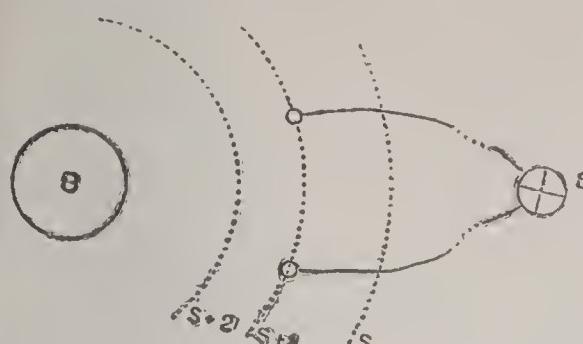


Fig. 7.

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but when we follow Faraday in regarding the dielectric as of at least equal importance as the conductor, the conception of the potential is found to be one of peculiar value. Thus any conductor or any system of connected conductors must have all points at the same potential ; whereas, in a dielectric, the potential may vary from point to point, and indeed must vary if the dielectric is separating two conductors at different potentials.

Within such a dielectric we may suppose traced out, after the manner of the last experiment, a series of equipotential surfaces. To fix our ideas, let the one conductor be completely inclosed within the other—say, a spherical globe within a concentric spherical shell—and let this outer shell be put to earth, and let us call its potential zero. Then we know by Experiments II. and IV. that the electric field exists only in the region between the shell and the globe, which we shall suppose to be at a high potential V . The symmetry of the system requires that the other equipotential surfaces all shall be spheres concentric with the globe and shell. Now we may compare this electrical system of globe, shell, and intermediate equipotential surfaces to a

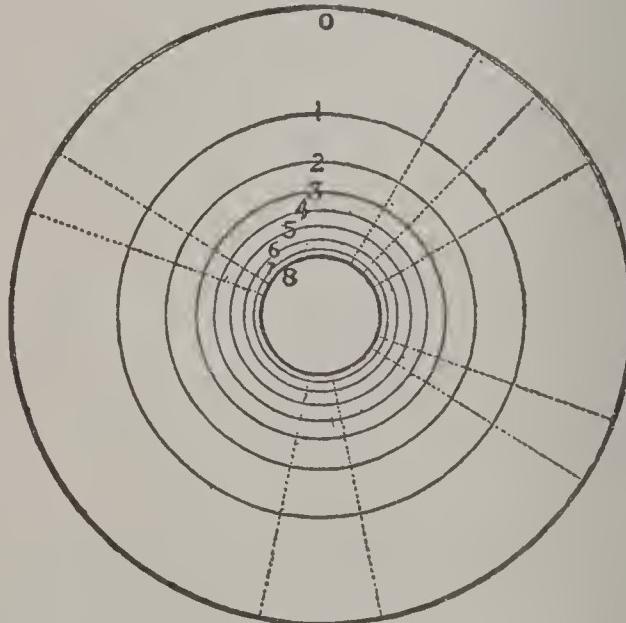


Fig. 8.

system of Contour (q.v.) lines representing a hill with a flat top, rising up from the sea-level—the successive equipotential surfaces in the electrical system corresponding to successive equal-level lines in the geographical system. If the substance of the hill were to become fluid, the whole would be reduced to the sea-level, and the contour lines would be effaced. So, if the dielectric were to become conducting, the equal and opposite charges (see Experiments II. and IV.) on the globe and shell would combine and destroy each other, and the electric field with its imaginary equipotential surfaces would cease to exist. Again, to carry one pound of matter from the sea-level up to the top of the hill requires so much work to be done against gravity (see ENERGY), and this amount of work is proportional to the height lifted through—i.e., to the number of contours crossed.

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So, in the electrical system, to carry a small positive charge from the shell to the globe will require so much work to be done against the electrical forces, and this amount of work will be proportional to the number of equipotential surfaces crossed. Further, exactly as the pound of matter taken to the top of the hill will add to the height of the hill, so will the addition of this small extra charge to the globe increase its potential. We must not, however, push the analogy too far, since in the one case the force of gravity overcome is constant and acts downward, whereas in the other the electric force varies inversely as the square of the distance from the centre and acts outward.

We have assumed in the above discussion that the successive equipotential surfaces, experimentally determined by means of the quadrant electrometer, are really such that the work done in carrying a given small charge over the interval separating any two contiguous surfaces is the same. It is usual in treatises on the subject to begin with the dynamical definition of the potential at a point as the work done in carrying a unit of positive electricity from infinity to that point. It is then shown that the quadrant electrometer is an instrument so constructed as to fit into this definition.

Assuming, then, that our equipotential surfaces have the property mentioned, we are in a position to study the energy relations of the electric field.

Coulomb established by experiment that the force of repulsion between two similarly charged bodies was directly as the product of the charges. Hence, as the charge of the globe inclosed in the shell is increased, the electric forces in the field increase in the same proportion. Hence the work done in carrying a given charge from the shell to the globe against the electric forces increases in the same ratio. In other words, the number of equipotential surfaces in the field grows uniformly with the charge. If the potential of the globe is V , we may write the charge CV , C being a constant so long as the geometrical dimensions of the system remain unchanged. Since the shell is always kept connected to earth—i.e., at zero potential—there is a charge $-CV$ distributed over the inside of the shell. To add a small extra charge to the globe may be regarded as equivalent to taking this small charge from the shell, carrying it across the dielectric, and distributing it over the globe. The work done in effecting this is evidently proportional to the charge taken and to the number of equipotential surfaces crossed. But as the extra charge is added, let us suppose, at a steady rate, the potential of the globe is increased at a proportional steady rate. Hence the whole work done in adding a given charge is equal to the product of the charge and the mean potential of the globe during the operation. Thus, in charging the globe from zero potential to potential V , we do an amount of work equal to half the product of the final potential V into the final charge CV —in symbols $\frac{1}{2}CV^2$ or $\frac{1}{2}QV$ or $\frac{1}{2}Q^2/C$, where Q is the charge, and C the constant which depends on the geometrical dimensions of the system.

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We have already seen that positive and negative electrifications always coexist—that it is impossible to generate so much positive charge without at the same time generating as much negative charge. Faraday took implicit account of this truth in his conception of lines of electric force traversing the dielectric. Since no work is done against the electric forces in passing along an equipotential surface, we readily see that the electric force at any point is perpendicular to the equipotential surface there. This direction is, in fact, the unique direction of separation of the two terminal spheres in Experiment V., which, for a given distance of separation, gave the maximum deflection. If, starting from any point, we move always perpendicular to the equipotential surface through which we are for the moment passing, we shall describe a curve which at every point of it is tangential to the direction of the electric force there. Such a curve is called a line of force. Take any small area on an equipotential surface, and draw lines of force through its perimeter. These lines of force will form a so-called tube of force, whose section in general will vary as we pass along it. Following this tube of force backward to its source, we shall finally come to a positively charged conductor; and following it forward we shall ultimately come to a negatively charged conductor. Every such tube of force has, in short, two ends. It springs perpendicularly from a positively charged area, and terminates, also perpendicularly, on a negatively charged area. According to Faraday's view, and to the view now generally accepted, it is along these tubes of force that electric induction takes place; so that the negative charge on the terminal area is exactly equal to the positive charge on the area from which the tube springs.

In the symmetrical system of globe and shell, the lines of force are obviously straight radial lines, the tubes of force portions of cones terminated by the spherical surfaces. Some of them are indicated by the dotted lines in fig. 8. If we take each tube as springing from an area bearing unit charge, then there will be in the region as many tubes of force as there are units of charge—i. e., there will be Q ($= CV$) unit tubes of force. These Q unit tubes of force with the V equipotential surfaces will cut up the dielectric into QV imaginary cells, each of which may be regarded as containing half a unit of energy. In fact, exactly as a stretched piece of India-rubber contains in every element of it so much energy in virtue of the elastic stresses acting throughout it, so we are to regard an electric field as a kind of strain existing in the dielectric, so that in every element of the dielectric so much electrical energy is stored up in virtue of the electric stresses. Every complete unit tube of force contains $\frac{1}{2}V$ units of energy; and between any two complete equipotential surfaces differing by unity there are $\frac{1}{2}Q$ units of energy stored up. Clearly the electric strain will be greatest where the unit tubes of force are narrowest and where the equipotential surfaces are closest.

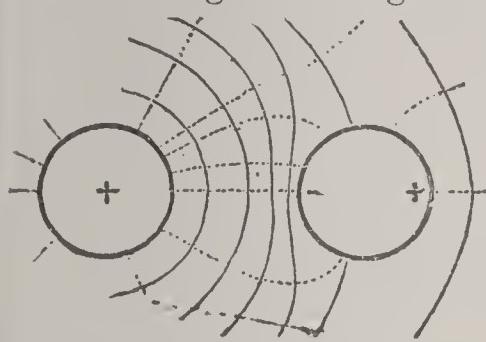
Suppose, now, that in the region between the globe and

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shell an insulated conductor originally unelectrified is introduced; or, what comes to the same thing, suppose a marked-off region in the electric field to become conducting—this region will at once be reduced throughout to the same potential, and its surface will form part of an equipotential surface. But, since originally the potential in this region fell steadily as we passed outward from the globe, a transference of charge must have taken place also outward in order that the potential should become equalized throughout. The introduced conductor in fact acts as a channel along which electrification is transferred; so that, if tested, the end facing the globe will be found negatively electrified, and the farther end positively electrified.

Now it is evident that the introduction of this conductor into the field has very much changed the configuration of the equipotential surfaces in its vicinity, the new configuration being something like what is indicated in the dia-

gram (fig. 9). As a consequence, the tubes of force, which are necessarily perpendicular to the equipotential surfaces, must also suffer a corresponding change of configuration. A certain number, springing from the globe, will fall perpendicularly on the nearer part of the introduced conductor, while from the farther part



The diagram illustrates the effect of an introduced conductor on the electric field. On the left, a large circle represents a charged conductor (globe) with a positive charge (+). It is surrounded by solid lines representing equipotential surfaces and dashed lines representing tubes of force. On the right, a smaller circle represents an introduced conductor with a positive charge (+). It is also surrounded by solid and dashed lines representing its own electric field. The tubes of force from both conductors converge and diverge around the introduced conductor, showing how the field is altered by its presence.

Fig. 9.

an equal number of tubes of force will spring and continue outward to the shell. Where the tube ends on a conducting surface, there we find unit negative charge; and where it springs from a conducting surface, there we find unit positive charge. Thus, by consideration of the equipotential surfaces and tubes of force, we are led to a conclusion in strict accordance with the experimental truth that an uncharged conductor brought near a charged conductor becomes electrified by induction, so that the nearer end shows an opposite charge, and the farther end shows a similar charge, to that which exists on the charged conductor.

Generally speaking, the effect of the presence of the introduced conductor is to crush the tubes of force in the neighborhood closer together, and therefore (since this number remains constant) to compel an expansion of them elsewhere. The terminals of the tubes on the globe will obey the same tendency toward concentration and expansion. In other words, the charge Q , at first distributed uniformly over the globe, becomes redistributed and tends to accumulate on the side facing the conductor. The nearer the conductor and globe are brought, the greater will this tendency be, and at last, when they are near enough, the dielectric is unable to sustain the high electric tension along the ever-shrinking tube of force. It yields, a more or less sudden transference of charge takes place in the form usually of a spark, the potentials of the globe and conductor are practically equalized, and the tubes of force between them are annihilated.

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This is the phenomenon which is exhibited on a large scale in every lightning-flash, and on a small scale in every spark between electrified bodies.

Suppose, however, that before this catastrophe has taken place, the conductor is joined by a wire to the surrounding shell, and consequently brought to zero potential. All those equipotential surfaces which at first inclosed the conductor—i.e., lay between it and the inclosing shell—will be shifted so as to lie between it and the globe. The tubes of force will shift correspondingly; and as no tube can now pass from the conductor to the shell, none will spring from it. Hence the charge on the conductor will be wholly negative. Now experiment shows that when the conductor is brought to zero potential in the way just described, a spark always passes at the instant the connection is made. This spark means so much energy in the form of light, sound, and heat, and must therefore mean a disappearance of energy in some other form. This cannot be other than electrical energy. Consequently the number of unit cells in the dielectric must be diminished. But the charge on A has not changed, so that the number of tubes of force is exactly as before. The change must therefore be in the number of equipotential surfaces; and since the shell and the conductor are at zero potential, the diminution must take place in the potential of A. Thus we see that the potential of a positively charged body is diminished if a conductor at zero potential is brought near it.

This result leads naturally to the discussion of *capacity*. The capacity of a conductor is measured by the ratio of its charge to its potential. Hence if, as in the experiment just described, we have a diminution of potential with constant charge, this is equivalent to an increase of capacity. The greater the capacity of a conductor, the greater the charge it can hold at a given potential. Hence if a number of conductors are at the same potential, the charges must be distributed among them directly as the capacities. The experiment just described shows how we may arrange matters so as greatly to increase the capacity of a given conductor. It is sufficient to have close to it another conductor at zero potential. Such an arrangement of conductors is called an *accumulator* or *condenser*; and the most familiar

form of accumulator used in electrostatic experiments is the Leyden jar, so called from the city, where, in 1745, its properties were accidentally discovered by Cunæus. About the same time, possibly a month or two earlier, almost exactly the same discovery was made by Kleist at Kammin in Pomerania. In its modern form, a Leyden jar is a cylindrical glass bottle, lined inside and outside with metal-foil up to within a short distance from the top. A brass rod connected below with the inside coating passes upward through the cork or stopper, and terminates generally in a ball or knob.



Fig. 10.

A Leyden jar then consists essentially of two conductors,

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the one almost completely inclosed in the other, and separated from it only by the thickness of the dielectric. If either conductor is put to earth, and the other insulated and charged, an opposite and nearly equal charge is induced on the former. If we could completely surround the one conductor by the other, the induced charge would, as we have seen, be exactly equal but opposite to the inducing charge. Leyden jars are indispensable for carrying out illustrative experiments in electricity. When used in combination, they are said to form an electric battery.

The essential nature of the mode of action of an accumulator or condenser may be illustrated as follows: Take any-charged conductor with its associated electric field. Let Q be its charge, V_0 its potential, so that $\frac{1}{2}QV_0$ is the measure of the electric energy stored up in the field. Having fixed our attention on any equipotential surface V_1 inclosing the conductor, let us suppose this surface to become conducting. There will be no transference of charge over this surface, because it is from the very beginning an equipotential surface. There will be no change of the electric field either inside or outside the surface V_1 ; but these two regions will now be separated by a conducting surface. So far as the outside region is concerned, we may regard the charge Q as distributed over a conductor co-extensive with the conducting surface V_1 (see Experiments III. and IV.), and may quite disregard the existence of the original conductor at potential V_0 . The electrical energy stored up in this outside region is therefore a $\frac{1}{2}QV_1$. Let us now connect this new-formed conductor to earth, so as to reduce it to zero potential. By so doing, we discharge the conductor, completely destroying the electric field outside of it and the $\frac{1}{2}QV_1$ units of electric energy stored up in it. This therefore is energy lost to the original system; and the energy stored up in the dielectric separating the two conductors becomes a $\frac{1}{2}Q(V_0 - V_1)$. Now, since the inclosing conductor has been reduced to zero potential, the quantity $(V_0 - V_1)$ must represent the new potential of the inclosed conductor.

In short, the bringing of the inclosing conductor to zero potential, being a purely external electrical change, has in no way altered the *configuration* of the equipotential surfaces and tubes of force inside; it has simply *reduced the potential values* throughout by the same amount—viz., the potential of the inclosing conductor before it was put to earth. The potential of the inclosed conductor has fallen from V_0 to $V_0 - V_1$; and hence, as the charge Q has remained

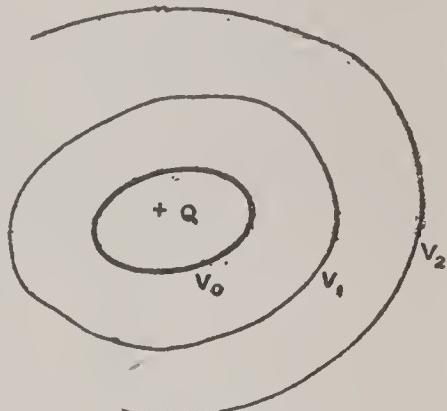


Fig. 11.

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unchanged, the capacity has increased in the ratio $V_0 - V_1 : V_0$. Thus, with either conductor fixed in size, the capacity of the system grows greater and greater as the thickness of the separating dielectric is diminished. If, as in almost all practical cases, the dielectric is very thin compared to the size of the conductors, we may assume that the successive equipotential surfaces come at sensibly equal intervals, so that the surface half-way between the conducting surfaces will have approximately a potential value half-way between the potentials of the conductors. Thus it is easily seen that for a condenser built up of closely opposed surfaces, whether plates or cylinders, separated by a given dielectric, the capacity varies inversely as the thickness of the dielectric.

Take, e.g., two concentric spheres, one slightly larger than the other, and let the inner one have a charge Q , and the outer one be at zero potential. The negative charge on the outer sphere will, by a well-known proposition in attractions, exert no electric force throughout its interior. Hence, if a is the mean of the radii of the spheres, we may write Q/a^2 as a very approximate value for the mean electric force acting in the region separating the spheres. If t is the small distance between the two surfaces, the work done in carrying unit charge from the outer to the inner surface is Qt/a^2 , the product of the distance into the mean force. This therefore measures the difference of potential of the two spheres, so that a^2/t is the capacity. Now, we shall suppose that t is kept constant, and that a is made to grow indefinitely; then if we write $Q = 4\pi a^2 \sigma$, the quantity σ will be the charge on unit area of the inner surface. Hence, ultimately, when the concentric spheres become two parallel planes, the difference of potential between them is measured by the quantity $4\pi\sigma t$, where σ is the charge on unit surface of the one plane, $-\sigma$ the charge on the opposing surface of the other, t the distance between the planes, and π the ratio of the circumference of a circle to its diameter. The force is measured by the rate at which the potential changes, in this case simply $4\pi\sigma$, and is therefore the same not only at every point between the planes, but also for all values of t .

Now we may calculate the electric force very close to any charged surface on the supposition that the contiguous surface element is part of an infinite plane having the same charge per unit area—in other words, the same surface density. By surface density at any point of a charged conductor we mean the limit of the ratio of the charge on a small element containing the point to the area of the element, as the element is taken smaller and smaller. Such is the quantity σ just discussed. Thus the electric force just outside a charged conductor is equal to $4\pi\sigma$, where σ is the surface density at the contiguous point of the conductor. It is a repulsion when σ is positive, an attraction when σ is negative.

We may use the result above obtained for finding the force acting on an element of the charged surface itself.

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Consider the two parallel planes at distance t and difference of potential $4\pi\sigma t$, σ

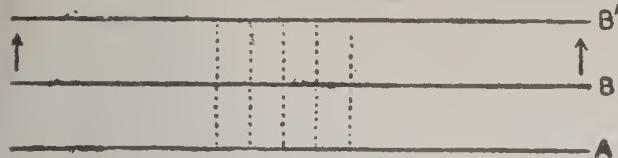


Fig. 12.

σ being, as above, the charge on unit area. Hence the energy stored up in a tube of force stretching from the unit area on B to that on A

is $\frac{1}{2}\sigma \times 4\pi\sigma t = 2\pi\sigma^2 t$. Now, with A at zero potential, let B be moved away to double its original distance from A—i.e., through a distance t to B'. If the charge on unit area remains constant, the energy stored in the corresponding tube of force has become simply doubled, so that there has been an increase in electrical energy represented by the quantity $2\pi\sigma^2 t$. But this must be equivalent to the work done in removing the charge σ through the distance t against the electrical force; hence, the value of this force estimated per unit charge must be $2\pi\sigma$. Thus the force per unit charge acting *on the surface* is just half the electric force acting on unit charge at a point in the field just outside the surface. Otherwise, if F is the electric force at a point just outside a charged surface, $F/4\pi$ is the measure of the surface density at the contiguous surface element, and $\frac{1}{2}F$ is the force per unit charge acting on the surface.

The importance of this result is that it gives a simple method of measuring electric force in terms of weight. It is the principle of Thomson's absolute electrometer, which is essentially two parallel plates at different potentials, one of which is made so that a small area at its centre is movable under the action of the electrical force. Where this small area is, the electrical system does not differ appreciably from what would be the case if the plates were really

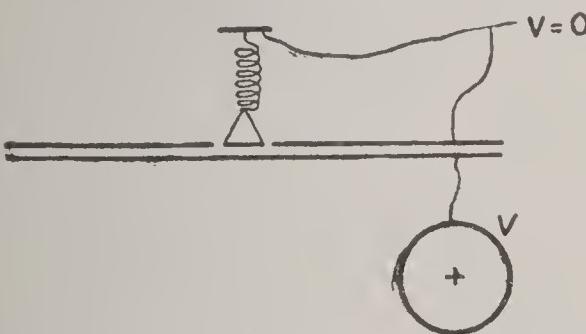


Fig. 13.

infinite. We may suppose the small area suspended by a spiral spring, and that, when the plates are at the same potential, W grammes must be laid on the small area to bring it so that its lower surface is flush with the lower surface

of the rest of the upper plate. Let the weight W be removed, and the lower plate be put in connection with the conductor whose potential is to be measured. Now raise or lower this plate until the small area, which with the rest of the upper plate is kept at zero potential, is brought again to be flush with the upper plate. Then we know that the suspension is stretched by a force equal to the weight of W grammes. Now, if the potential of the lower plate is V , and t the distance between the opposed surfaces, V/t is the electric force in the region between the surfaces, and $V/4\pi t$ the measure of the charge on unit area. Hence, the force

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acting on unit area is $\frac{1}{2}V/t \times V/4\pi t$; and finally, if A be the area of the small suspended portion, we have

$$W = \frac{V^2 A}{8\pi t^2}.$$

In this equation, W, A, t, are all known; hence V is measured in terms of definite units. In the universally adopted system of scientific dynamic units, we must multiply W by the quantity g , which measures the number of units of force equivalent to the weight of one gramme. Then we find

$$V = t \sqrt{\frac{8\pi g W}{A}}.$$

As a special case, suppose that W is 50 grammes, and A one square centimetre; then, with $g = 981$, we find $V = 1110 t$, and 88.3 units of charge on the unit area. The unit of charge here referred to is that quantity which when placed at 1 centimetre from an equal quantity will repel it with a force of 1 dyne—i.e., a force which, acting on 1 gramme for 1 second, will increase its velocity by 1 centimetre per second. This quantity is called the electrostatic unit of quantity; and the electrostatic unit of potential is the potential of a sphere of radius 1 centimetre, and charged with this unit quantity.

Generally speaking, except in such obviously symmetrical cases as concentric spheres, infinite co-axial right cylinders, and infinite planes, the surface density will vary from point to point of a conductor, and where it is numerically greatest there also will the electric force close to the surface be greatest. In the case of a simple elongated conductor, the surface density is greatest at the ends. This may be proved very easily by experiment, by, for example, measuring the charge which a very small disk carries away after contact with the conductor. The following reasoning will lead to the same conclusion. Take a uniformly charged sphere in wide space, so that the equipotential surfaces are concentric spheres, and the tubes of force radial cones. If this sphere, by appropriate expansion at right angles to a given diameter, becomes changed into an oblate spheroid, what is the nature of the accompanying change in the surrounding electric field? Let OY be the given diameter, and consider a tube of force symmetrical about any axis OX perpendicular to OY. Let APQB represent this tube of force for the sphere. Along this tube induction takes place, so that the positive charge on PQ would induce an equal negative charge on AXB, if the equipotential surface, of which AXB is a part, were to become a conducting surface. We may express this by saying that the electric displacement across any section AXB of a tube of force is equal to the charge on PQ, the area from which the tube springs. Now let the sphere change form in the manner described, but to such a small extent that no appreciable change is produced at the distance OA. The electric displacement across AXB is therefore the same as before;

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and, if we follow back the tube of force to the conductor, we shall find the corresponding charge distributed over the area from which the tube springs. But, the conductor being itself an equipotential surface, the lines of force must meet it perpendicularly. Hence, near the deformed conductor, each line of force will suffer a displacement as shown in the figure, where AP' represents the new position of what was originally the line of force AP . Similarly the

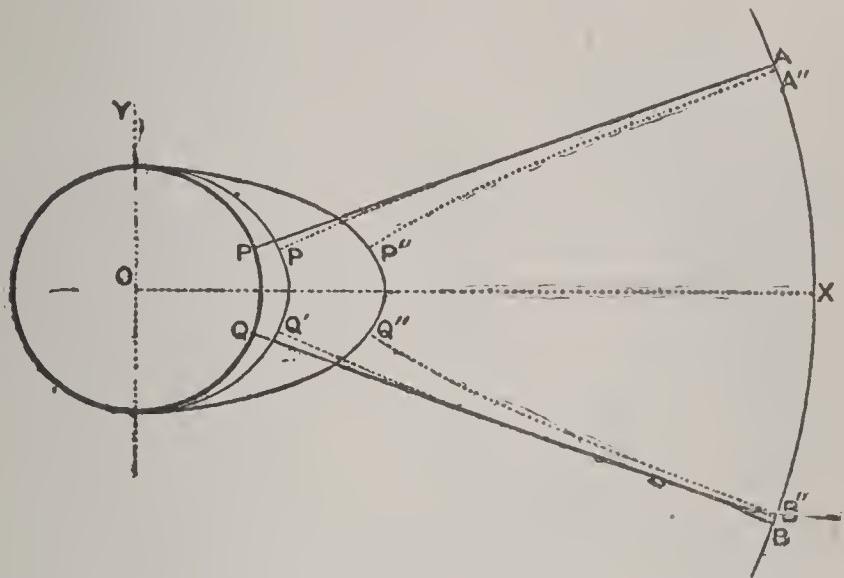


Fig. 14.

line BQ will bend inward to the position BQ' . In other words, the tube of force as it springs from the spheroidal surface $P'Q'$ lies wholly within the tube of equal strength which sprang at first from the spherical area PQ . The unit tubes of force which compose the tube which passes through AB are, therefore, more concentrated in the region $P'Q'$ than they were in the region PQ . Hence, the remaining unit tubes of force which spring from the rest of the conducting surface are, taken as a whole, more expanded over the rest of the spheroid than they were over the rest of the sphere. Thus, the average density over $P'Q'$ is greater than the average density over the rest of the spheroid. Now we may suppose this almost spherical spheroid to become elongated little by little. At every step a readjustment of the lines of force will take place, until at length for a pronounced ellipticity they come into the positions $P''A''$, $Q''B''$. At an adequate distance, however, these lines of force will be indistinguishable from the original positions PA , QB . Hence, the electric displacement across a far-away section of the tube being as before, the charge on $P''Q''$ will be the same as that originally borne by PQ . Thus, the more elongated the ellipsoid becomes, the greater is the relative concentration of charge toward the ends. It may be easily shown that the lines of force springing from $P''Q''$ are branches of a hyperbola confocal with the spheroid, and having PA , QB , for asymptotes.

This accumulation of electric charge toward the ends of a pointed conductor is well exemplified in the lightning-conductor, which is simply a very elongated piece of

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metal in contact with the earth. A charged body of air, such as accompanies a thunder-cloud, passes near it. The tubes of inductive force are at once concentrated on the elongated conductor; the electric force at the point becomes so intense that the air can no longer act as a perfect insulator; electrical discharge takes place along these very tense tubes of force; and in a more or less gradual manner the cloud is robbed of its charge, and the evil effects of a sudden lightning-flash minimized. On the same principle, electric discharge through air is facilitated by the use of pointed conductors, such as the combs which are so important a detail in machines for generating electricity by means of friction.

We have seen that the capacity of a condenser depends on the distance between the surfaces or plates which compose it; it also, however, depends very materially on the nature of the dielectric. Suppose, e.g., that we have a series of condensers of the same conducting material, and all exactly equal as regards their geometrical and space relations, but all differing as regards the dielectric which separates their plates. Thus let one have air as its dielectric, another plate-glass, another paraffin, another mica, and so on. Let them all now be brought to the same potential, then disconnected and tested as to charge. The charges will be found all different—being, in the four cases mentioned, approximately proportional to the numbers 1, 6, 2, 6·6. These four numbers are the values of what is termed the *specific inductive capacity* of air, glass, paraffin, and mica. Thus by merely inserting a plate of mica between two plates of an air condenser, we increase the capacity by as much as if we had approached the plates in air through a distance equal to $.85 (=5.6/6.6)$ of the thickness of the mica. Otherwise, let there be two metal plates, A, B, separated by a thin plate of mica, and on

the other side of A let a third equal-sized plate C be so adjusted that when A is charged, the potentials of B and C shall be equal. This can be readily done by severally connecting B and C to the electrodes of the electrometer, as indicated in the figure. Then it will be found necessary to adjust C so that the distance between A and B is about 6·6 times the distance between A and C.

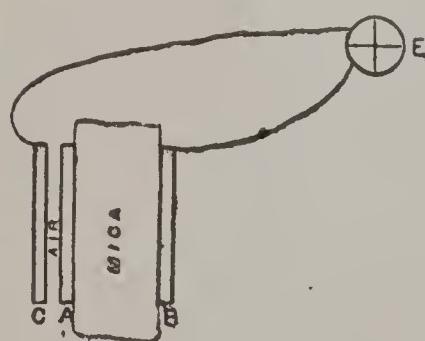


Fig. 15.

We may now fitly consider the principles of action of the various machines that are used for generating electricity. The rubbed pieces of resin, sulphur, glass, etc., were gradually succeeded by spheres, cylinders, and circular plates of these materials, which, as they revolved against prepared rubbers, were kept in a constant state of electrification. Any insulated conductor brought near enough to a portion of such a cylinder or plate at a distance from the rubber will be-

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come charged, the dielectric strength of the air breaking down exactly as in the case of the lightning-conductor and the thunder-cloud. Such is the action of the ordinary frictional machine; obviously the conductor acquires a charge similar to that on the revolving cylinder or plate. The opposite charge on the rubber may be transferred to another conductor, which is usually put to earth. Le Roy's or Winter's plate machine is shown in the diagram (fig. 16).

Essentially different in its action is the electrophorus invented by Volta 1771. In its most improved modern form it consists of two plates, one of metal, the other of resin, vulcanite, or ebonite backed with metal. Insulating handles can be screwed on to the backs of the plates; and one plate at least must be so insulated. The surface of the ebonite is first electrified by friction, and the metal plate is brought into close contact with it. The metal plate, from its greater proximity to the negatively charged surface of the ebonite, will be at a lower potential than the metal back to the ebonite. If these are then brought into contact—conveniently effected by means of a metal pin passing through the ebonite—a transference of charge will take place, so that the metal plate when lifted away will be found positively charged, while the metal back is left negatively charged. In this machine, the original negative electrification on the rubbed surface of the solid dielectric is used again and again, in accordance with the principles of electrostatic induction and convection, to produce a practically unlimited amount of either kind of electrification.

In Nicholson's 'revolving doubler' is seen the parent form of a number of rotatory machines which, like the electrophorus, depend for their action on induction and convection. They make direct use of the principle of 'doubling' discovered by Bennet, by which the difference of potential between two conductors is indefinitely increased. Thomson's replenisher, an important part of the quadrant electrometer in its perfected form, is perhaps the simplest and most compact of these machines. In it, a turning vertical shaft of ebonite bears, at the ends of a horizontal cross-piece of ebonite, two metal pieces called carriers (*cc* in the diagram, which represents a hori-

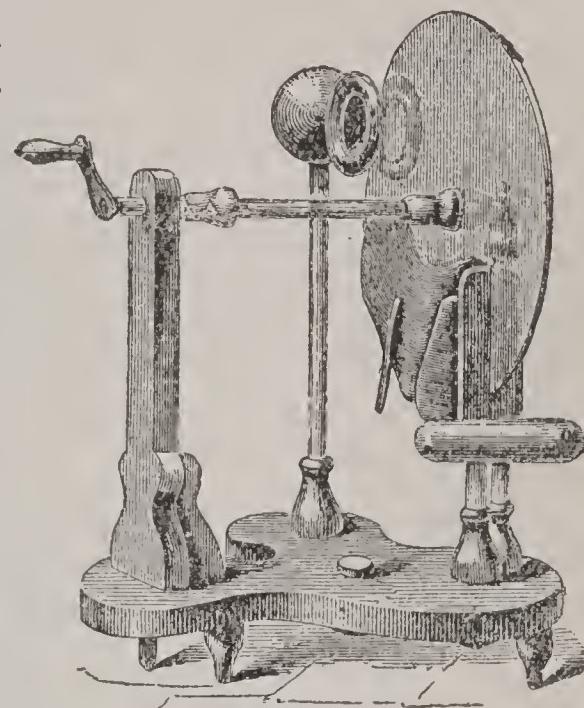


Fig. 16.

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zontal section). These carriers rotate in the region between two insulated metal inductors (*a*, *b*) in the form of cylindrical segments. When the carriers are in position AB, they come into momentary contact with delicate springs attached to the neighboring inductors; and when they are in position CD, they come into momentary contact with delicate springs connected by a metallic arc quite insulated from the inductors. Suppose *a* to be a

higher potential than *b*, and consider what takes place as *cc* rotates counter-clockwise, as shown by the arrows in the figure. In the position AB, the carriers are well surrounded by the metal shields, and will part with nearly all the charge that may chance to be upon them. Just before they come into contact with the springs in position CD, the two carriers are at different potentials. Hence at the moment of contact with the connecting springs, a trans-

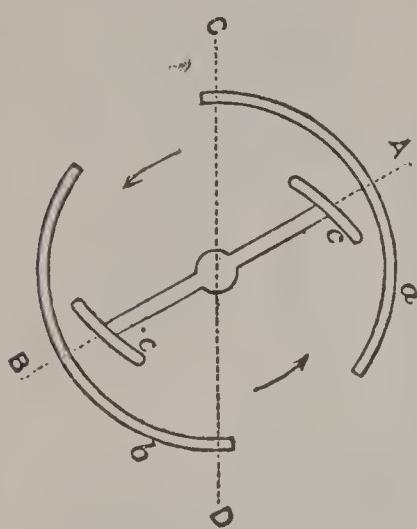


Fig. 17.

ference of charge will take place from the carrier near *a* to the carrier near *b*. The former will thus acquire a negative charge, and will move on till it comes within the inductor *b*, to which it will give up nearly all its negative charge; while the latter will simultaneously give up nearly all its positive charge to *a*. Thus every complete revolution each carrier becomes once negatively charged and once positively charged, giving up its negative charge to the one inductor, and its positive charge to the other. The inductors therefore steadily increase in positive and negative charges, or in other words, their difference of potential steadily grows. If the carriers are rotated clockwise, the opposite effect will take place, *a* acquiring so much negative charge every revolution, and *b* so much positive charge. In the electrometer, *a* is in connection with the charged body, which is suspended inside the quadrants. A very elegant contrivance enables the operator at once to tell if this body is charged to its normal condition. If it is undercharged, a few turns of the replenisher in the proper direction will bring the potential up to its proper magnitude; if it is overcharged, a few turns in the reverse direction will bring the potential down to its required value.

The same principles of induction and convection are made use of in the so-called influence machines, which in recent years have quite eclipsed the older frictional machine. These are generally known by the name of their inventors, such as Töpler, Holtz, Bertsch, Voss, and Wimshurst. Of these, the Wimshurst is the latest, and apparently the most satisfactory. It consists of two circular glass plates, mounted on a common spindle, and

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capable of rotation in opposite directions with equal speeds. Each plate carries twelve or sixteen strips of thin sheet-metal, fixed radially at regular intervals apart. These strips lie on the outside of the closely opposed glass plates. At the extremities of the horizontal diameter of the plates the main conductors are placed, insulated on glass or vulcanite pillars. Horizontal arms with the usual combs project inward, embracing both plates as far as the inner ends of the metal strips. In front is fixed a diagonal conductor, called a 'neutralizing rod;' and a similar rod is fixed behind at right angles to the one in front. These neutralizing rods terminate at both ends in a small metal brush, which touches the metal strips or carriers as they pass. By this contact of brushes and strips, every strip on either plate is, very soon after it has passed under the collecting combs, brought into metallic connection for a moment with the strip diametrically opposite it on the same plate.

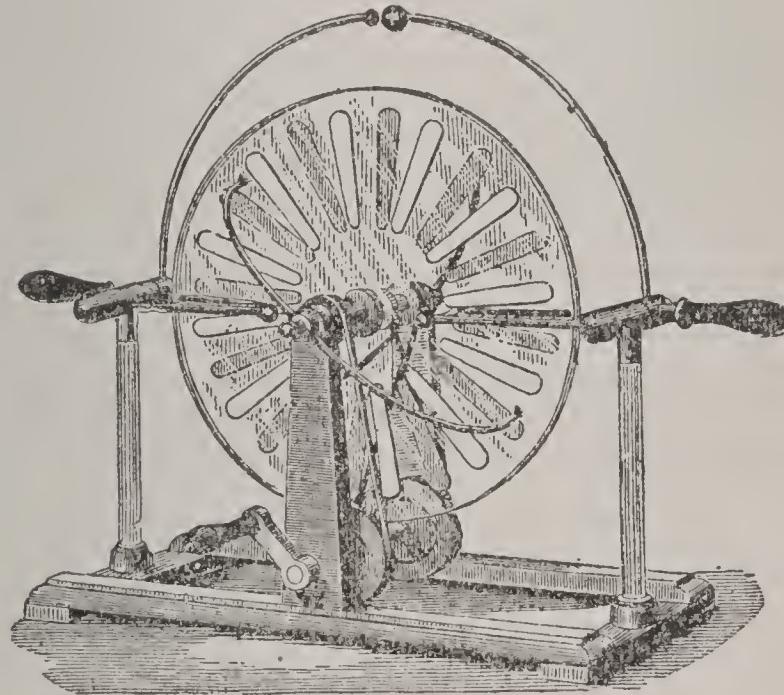


Fig. 18.

Suppose the principal conductors to be at different potentials, then—exactly as in Thomson's replenisher—the carriers as they leave the brushes of the neutralizing rod will acquire a charge, negative or positive, according as they are nearer the positively or negatively charged main conductor. But, evidently, each carrier on the one plate will act as inductor to the carriers on the other plate; and a moment's consideration will show that this inductive action will everywhere accentuate the inductive action of the main conductors. Thus the positive conductor is being fed by the positive charges brought by the strips on the upper half of the one plate and on the lower half of the other; while the negative conductor is being fed by the negative charges brought by the strips on the lower half of the one plate and the upper half of the other. The main conductors are provided with arms, which reach out

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toward each other, and between whose terminal knobs discharge takes place. Sparks, 3 to 5 inches in length, can easily be obtained with this machine.

So far we have confined our attention almost entirely to electrostatic phenomena—i.e., to phenomena connected with the existence of a steady electric strain in dielectrics. When compelled to deal with the transference of so-called charge from conductor to conductor, we had regard rather to the initial and final equilibrium conditions than to the intermediate condition of change. This condition of change, however, has clearly very important energy relations. In all cases of electrical discharge there is, in the language of Faraday, a concentration of the lines of force in a certain region of the dielectric, until that becomes, as it were, overstrained, and yields with more or less evident appearance of part of the energy of strain in the form of light, sound, and heat. The particular manner of transformation into these commoner forms of energy depends on a variety of circumstances, such as the pressure and temperature of the dielectric, the form and relative size of the conductors, and so on. Even if there be no such energy transformations apparent to our senses, it can be shown that any equalization of potential without increase of total charge necessarily results in a loss of electric energy to the system.

Thus, let there be two insulated conductors of capacities C and C' , originally at different potentials. If they are brought to the same potential V by being connected by a thin wire of comparatively insignificant capacity, the original charges on the conductors will become redistributed, and the final charges will be CV and $C'V$. Whatever charge the one conductor has lost, the other has gained. Hence we may write the original charges as $CV + q$, $C'V - q$, where q is the charge which has been transferred from C to C' . Now the energy of any charged conductor is measured by half the charge into the potential or half the square of the charge divided by the capacity. Thus the final energy, after equalization of potentials, is:

$$\frac{1}{2}CV^2 + \frac{1}{2}C'V^2,$$

while the initial energy was

$$\frac{1}{2}\frac{(CV + q)^2}{C} + \frac{1}{2}\frac{(C'V - q)^2}{C'} = \frac{1}{2}CV^2 + \frac{1}{2}C'V^2 + \frac{1}{2}q^2\left(\frac{1}{C} + \frac{1}{C'}\right).$$

Hence, since $\frac{1}{2}q^2\left(\frac{1}{C} + \frac{1}{C'}\right)$ is always positive, we see that the initial energy is necessarily greater than the final energy. The loss of energy is represented by a quantity proportional to the square of the charge that has been transferred. If we look more closely into the significance of this quantity, we see that it represents the electrical energy of the system of two conductors of capacities C and C' when they are charged each with q units of either positive or negative electricity; or, more particularly, it repre-

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sents the work which must be done in carrying q units from the one to the other. This is an example of the general principle that the work done by the electric field in compelling a transference or flow of electricity from one region to another is exactly equal to the work which must be done against the electrical forces in carrying an equal quantity of electricity back again.

It is convenient, especially when the flow of electricity is the subject of consideration, to use the term Electromotive Force instead of Difference of Potential. We may suppose it measured by means of the quadrant electrometer. Thus if the regions A and B are connected severally to the electrodes of the electrometer, the deflection will measure the electromotive force acting along any conducting channel which may be supposed to bring A and B into communication. The flow of electricity which this electromotive force compels will tend to bring A and B to the same potential; and in the ultimate vanishing of the deflection on the electrometer we have the evidence of such a flow having taken place. But we may suppose that, by some means, notwithstanding the conducting channel between A and B, their difference of potential is sustained, so that the electromotive force acting along the channel is kept constant. Then the electrometer will show a steady deflection; while at the same time a steady flow of electricity will take place along the channel. This flow, whose existence is indicated only indirectly by the electrometer, must be measured by some one of its direct effects.

These effects are conveniently grouped into physiological, thermal, chemical, and magnetic.

The electric 'shock,' experienced when the experimenter uses himself as a discharging conductor, is a familiar example of the physiological effect of an electric current. The electric discharge causes a muscular contraction. In 1790 Galvani observed that the limb of a frog, when touched simultaneously by two different metals in contact, was convulsed exactly as if subjected to an electric shock; and Volta, following up this observation, discovered in 1800 a new source of electromotive force which could sustain an electric current through a conductor for a lengthened period of time. From this dates the development of Galvanic or Voltaic electricity, or, as it is now more commonly called, current electricity. The electric shock, however, depends on *variations* in the amount of flow; a steady current produces no shock, except when it is beginning or ending.

In the electric spark there are of course thermal effects; and generally, since, as we have seen, a transference of charge or flow of electricity means a loss of electric energy, an evolution of heat is a necessary consequence.

Toward the close of the 18th century the decomposition of water by an electric discharge was observed by Van Troostwijk and Deiman; while with Volta's electrical discoveries a new era in chemistry as well as in electricity was inaugurated.

None of these effects, however, give a ready method for

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measuring a steady electric current—i.e., the amount of electricity transferred across any section of the conductor in a second, or in any other chosen unit of time. For this we must go to the fourth group—viz., the magnetic effects of currents. This branch of the subject, which includes electro-magnetism, and as a consequence much of electrodynamics, dates from 1820, when Oersted of Copenhagen discovered the action of a current upon a magnet suspended near it. As a matter of history, the discovery was made by means of voltaic electricity; but that there was some close relation between magnetism and electricity had long been recognized by experimentalists. Lightning had been known to destroy and even reverse the polarity of ships' compasses. Steel and iron had been magnetized by discharging electricity through them; but the effects of such sudden discharges were extremely capricious, and quite baffled all attempts to co-ordinate them. We may, however, by discharging a Leyden jar through a carefully insulated wire suitably coiled round a magnet, show that at the instant of discharge the magnet is displaced.

The broad fact established by Oersted was that every electric current tends to make a magnet set itself perpendicular to the direction of the current. To make the effect specially apparent, the wire conveying the current should be coiled again and again round the region in which the magnet is placed. The same current is thus brought again and again into the vicinity of the magnet, and has a proportionately greater effect. An instrument consisting in this way of a coil of wire surrounding a magnet, free to rotate in some plane passing through the axis of the coil, is called a *galvanometer*. The coiled wire must be covered with gutta-percha, silk, or cotton thread, so that the contiguous coils may be insulated from each other; and, for ordinary purposes, the plane of the coil should contain the magnet when no current is flowing. We may suppose the magnet to be suspended horizontally under the influence of the earth's magnetic field; then the plane of the coil should contain the magnetic meridian (see MAGNETISM). The ends of the coiled wire are called the terminals of the galvanometer. When they are connected to conductors at different potentials, a current will flow round the coil of wire, and will indicate its presence by compelling the magnet to move out of its normal position of equilibrium. The tendency of the current in the coil is to make the magnet turn itself at right angles to the plane of the coil—i.e., to set itself along the axis of the coil, magnetic east and west. But this is resisted by the steady action of the earth's magnetic field. The result is a compromise, and the magnet is deflected from its normal position in the magnetic meridian through an angle which depends on the relative values of the current and the earth's magnetic force. Since the latter is practically constant, the angle of deflection will depend on the value of the current, being greater for the greater current. It is not our purpose under this heading to enter into the magnetic relations of currents: for that, see MAGNETISM. It is sufficient at present to know

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that in the galvanometer we have an instrument which can measure current, exactly as in the electrometer we have an instrument which can measure difference of potential or electromotive force.

In discussing the equalization of potential in electrostatics, we purposely confined our attention to one metal only. The reason was simply because, in general, two

different metals, or in fact any two different conductors, can never when in direct contact be at the same potential. The discovery of this fact we owe to Volta. Take, for instance, any four conductors BAXB, put them in series as in the figure, and connect the terminal members, which are of the same material, to the electrometer. According to the character of the conductors AXB, there may be, or

there may not be, a deflection on the electrometer.

(1) If there is no deflection, the two B's are at the same potential; and yet, according to Volta's discovery, the three different substances are at different potentials. This may be shown at once by breaking the chain at any of the separating surfaces, when a deflection on the electrometer will be observed. During this act of separation, the separating surfaces, one of which must of course be kept insulated, act like a condenser with a constant charge, the difference of potential changing because the capacity is changing. The reason why the B's are at the same potential is that, whatever be the differences of potential between B and A and between A and X, the difference of potential between X and B is always such as to restore B to its original value. Thus if the separation of B and A gives a deflection of 20 to the right on the electrometer, and the separation of A and X gives a deflection of 8 to the left, the separation of X and B is found to give a deflection of 12 to the left.

(2) If, however, there is a deflection produced on the electrometer, then we know that the two B's must be at different potentials, so that, if we connect them by wires to the terminals of the galvanometer, a current will be observed to flow. Such a combination of materials, in which two conductors of the same material are kept at different potentials by being linked together by at least two other and different materials, is called a voltaic or galvanic cell. If we join the two terminals either directly or by means of any other simple conductor, a current will necessarily flow round the circuit. But this current means a transference of charge from one conductor to another at a lower potential—i.e., a loss of electrical energy which is proportional to the square of the quantity transferred. Hence, if, as is practically the case, the electromotive force or difference of potential remains fairly steady, it must be because electrical energy is supplied as fast as it is being lost. Consequently there must be in the circuit somewhere an orig-

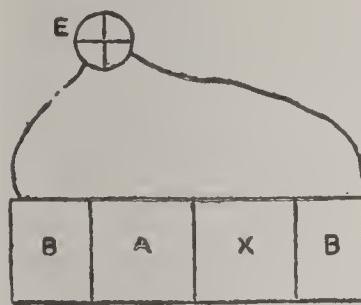


Fig. 19.

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inal source of energy. In fact it is found that a permanent electromotive force of the kind just described is always associated with a tendency to chemical action between two at least of the members of the chain; and that, when the circuit is complete and the current is flowing, chemical changes are going on within the cell. In this case, also, we may, by separating the chain at its various surfaces, show that at every surface there is an electromotive force of contact sustaining a difference of potential. But whereas, in the former case, the algebraic sum of all the differences of potential between the successive pairs of materials as we pass along the chain from B to B vanishes identically, in the present case it has a finite value, which is the total electromotive force of the combination as measured on the electrometer. A combination of two or more voltaic cells is commonly called a voltaic or galvanic battery.

There are innumerable forms of voltaic cells, built up in different ways of different materials. Copper and zinc dipping into dilute sulphuric acid is one of the simplest forms. When the cell is *closed*—i.e., when the copper and zinc are joined externally by a wire—a current will be obtained flowing in the wire from the copper to the zinc. At the same time the zinc will be dissolved in the acid; and it is from the energy set free by this chemical action that the electrical energy is derived. Such a single fluid cell is not, however, very steady in its action. We shall therefore take as a type of a good cell one of the class known as two-fluid cells; and of these we shall choose the Daniell cell. In its best form, the Daniell cell consists of copper and zinc plates dipping into saturated solution of sulphate of copper and semi-saturated solution of sulphate of zinc respectively—the liquids being also in contact but prevented from mixing by a porous septum. Connect the copper and zinc plates, or *poles* as they are technically called, to the electrometer. A deflection will be produced which will measure the electromotive force of a Daniell cell when it is not being used for the production of currents—i.e., when it is *open*. We shall take this, provisionally, as our unit electromotive force, and we may suppose the electrometer scale graduated so as to show unit deflection when the poles of a Daniell cell are connected to the electrodes of the electrometer. The deflection is such as to indicate that the electrode connected to the copper is at the higher potential. Hence the copper is spoken of as the positive pole, and the zinc as the negative pole.

Take now a second Daniell cell, connect its zinc to the copper of the first one, and connect the free poles to the electrometer. The electromotive force of the two cells so joined will be double that of one—i.e., equal to 2. And generally, when a number of cells are arranged in series (i.e., with the zinc of the first joined to the copper of the second, the zinc of the second to the copper of the third, and so on), the electromotive force of this battery, in terms of the "electromotive force of one cell, is just the number of cells composing it. Theoretically there is no

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limit to the electromotive force obtainable by means of cells; practically the difficulty consists in keeping a large number of cells in good condition. With a large enough battery we can obtain effects in every way analogous to the effects produced with frictional electricity. The electric light in its earliest form was obtained between carbon terminals joined to the poles of a large battery of cells. Generally speaking, however, the differences of potential in electrostatic experiments are much greater than the electromotive forces commonly used in experiments with electric currents. Thus, the electromotive force of a Daniell cell is very much smaller than the electrostatic unit of potential as measured on Thomson's absolute electrometer in the manner previously described. It would require a battery of about 278 Daniell cells set in series before the electrostatic unit of potential could be obtained; and it would require the use of about 10,400 cells in series to compel a spark to pass directly between two parallel plates connected to the poles and distant one-third of a centimetre from each other. With such comparatively small electromotive forces many substances can be used as insulators in current electricity which are fairly good conductors in electrostatics.

If at the same time that the poles of a cell are connected to the electrometer they are connected by stout short wires to the terminals of the galvanometer, the galvanometer needle will be deflected, while the electrometer deflection will be unchanged, or at the most diminished slightly. If thin long wires are substituted for the thick short connections, a very great diminution will be observed in the galvanometer reading, and perhaps a very slight increase in the electrometer reading, the apparent electromotive force of the closed cell approximating more closely to the electromotive force of the open cell. Thus, we may alter the current at will by employing different lengths and different thicknesses of wires for transmitting the current; and yet the electromotive force between the poles of the cell is but slightly if at all affected. In other words, the current, as measured on a galvanometer, depends not only on the electromotive force acting along the channel, but also on some property of the channel itself—some property independent altogether of electromotive force.

This property we may indicate by either of two words—viz.: Conductivity or Resistance. These words denote contraries. Thus, a body of small conductivity has a great resistance; and a body of low resistance has a high conductivity. Quantitatively, the one is the reciprocal of the other; and they are measured in terms of current and electromotive force by what is known as Ohm's Law. We now know (see *The Electrical Researches of the Hon. Henry Cavendish*, edited by Maxwell, 1879) that Cavendish had in 1781 established this law, and compared the resistances of iron wire and various saline solutions to electric discharge through them. He acted as his own galvanometer, and compared discharges by their 'shocks.' As regards the historical development of the science, however, it is to Ohm

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that we owe the full statement of the Law (1827). Since his day it has been subjected to the severest experimental tests that the scientific mind could imagine, and has stood them all. It is really the basis of our whole system of electrical measurements; and is to electric currents what the law of gravitation is to planetary motions. Ohm's Law asserts that the resistance of a conductor is measured by the ratio of the electromotive force between its two ends to the current flowing through it. Thus, if E is the electromotive force as measured on the electrometer, and I the current as measured on the galvanometer, and if K , R measure the conductivity and resistance respectively, Ohm's Law gives us these relations:

$$EK = I, \quad E = IR.$$

The Law is purely empirical. Assuming its truth, we shall here deduce from it certain relations, which experiment accurately verifies.

The peculiar value of Ohm's Law is in the fact that the property designated resistance, though measured in terms of electromotive force and current, is absolutely independent of them. Hence so long as the physical condition, and therefore the resistance, of each conductor remains unaltered, the currents in any system of conductors are proportional to the electromotive forces; steady currents imply steady electromotive forces; steady electromotive forces imply steady currents. And thus, if the potential at one point is steady, the potentials at all other points will be steady; and this means that whatever quantity of electricity flows into a point must flow out again—for otherwise there would be a gain or loss of charge at that point, therefore a change of potential, which is not contemplated. In the particular case of a single circuit, it follows that the current is the same at every part of it, and must therefore be regarded as flowing through the Daniell cell from the zinc to the copper, as well as through the rest of the circuit from the copper to the zinc.

If a steady current is flowing along a conductor of one kind of material, say a copper wire, the potential will fall off continuously as we pass along in the direction of the current. Let AB be the wire, and suppose the current to be flowing from A to B . Join B to one electrode of the electrometer; and let a wire from the other electrode be led to any point P on the wire. Then as the point of contact P is moved up toward A , the electrometer deflection will increase continuously. Even though AB is not all of one material, the same steady growth of the electrometer deflection will be shown as the point P is made to travel from

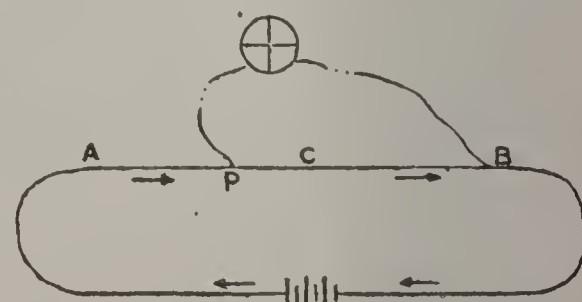


Fig. 20.

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B to A. Thus suppose AC to be zinc, and CB to be copper, and no current to be flowing; then according to Volta's discovery the potential, otherwise constant, will undergo an abrupt change at the surface of separation at C. But, as we have seen, the brass quadrants of the electrometer will not on this account be at different potentials, even though P lies in AC. Hence, if any difference of potential *shows itself on the electrometer*, it must be because a current is flowing along AB. Thus we may extend Ohm's Law to heterogeneous circuits.

The measurement or, more strictly, comparison of resistances is one of the most important operations in the modern science of electricity. For this purpose we first choose a certain standard, say a particular length of a particular piece of wire at a certain temperature. It is obviously convenient to have a standard which can be exactly reproduced should the first standard be lost or in any way damaged. Hence scientific men of all nations have agreed to use as the unit of resistance the resistance of a column of pure mercury 106 millimetres long, 1 square millimetre in cross-section, at the temperature of melting ice. This is called the *legal ohm*. It differs very slightly from the theoretic ohm, which is defined in terms of what are called the electro-magnetic units of current and electromotive force. See MAGNETISM.

Such a mercury standard, though fulfilling the very necessary condition of accurate reproduction, is not convenient for practical use. For this purpose copies of the ohm must be made in solid wires of some metal or alloy. German-silver has long been a favorite substance for making such practical standards; and of late a somewhat similar alloy called *platinoid* has come into use. Ohm's Law at once suggests a method for copying the standard mercury ohm. First, let the mercury column be included in a circuit with a given battery and galvanometer, and the deflection on the galvanometer noted. Second, let the mercury column be replaced by a wire, and the length of the wire adjusted till the galvanometer shows the same current. Then, provided that the electromotive force of the battery is the same in the two cases, the resistance of the substituted length of wire is 1 ohm. We may obviously construct an indefinite number of such copied standards.

If we put any number of these single ohms end to end in series, we shall get a whole resistance equal to as many ohms as there are conductors. This is an immediate consequence of Ohm's Law. For since it is the same current that is flowing through all the single ohms, the fall of potential as we pass from beginning to end of any one is the same for all; hence, the fall of potential as we pass along, say, three is three times the fall as we pass along one; hence, the current being the same for the three as for the one, the resistance of the three must be 3 ohms. A special case of this is that the resistance of a wire, otherwise constant in its physical relations, is directly as the length. The completely general statement is that the resist-

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ance of any single continuous channel is the sum of the resistance of its parts.

Suppose, however, that the single ohms are so arranged that they all begin at one point, A, in the circuit, and end at another point, B.

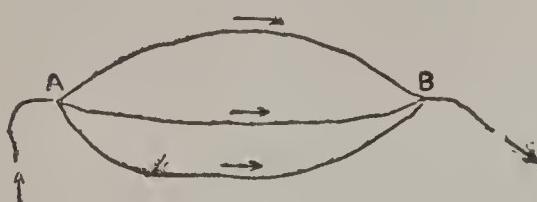


Fig. 21.

Then it is clear that they must all be traversed not by the same current, but by equal currents. Hence, there will flow into A and out of B a current equal to the sum of all these equal currents. Thus,

if there are, say, three single ohms connecting A and B, the total current flowing into A and out of B must be three times the current flowing in any one of the branches. But for constant electromotive force the current is directly as the conductivity, or inversely as the resistance. Hence, the conductivity of the threefold conductor between A and B is three times the conductivity of any one of its components; or, otherwise, the resistance between A and B is one-third of an ohm. Here, again, as a special case, we find that the resistance of a wire, otherwise constant in its physical relations, is inversely as the area of its cross-section. The completely general statement is that the conductivity of a multiple channel whose branches all begin at one point and end at another, is the sum of the conductivities of the branches. These multiple-arc arrangements, as they are technically called, are of peculiar value in all electrical investigations and applications. Cavendish, who states the law of the double-branch circuit with particular accuracy, was the first experimenter who used the arrangement. By discharging a Leyden jar through a branch circuit consisting of an iron wire and his own body he obtained a certain sensation, which he compared with the sensation produced when a column of salt water was substituted for the iron wire. By adjusting the length of the salt-water column until the two shocks felt equally intense, he had data from which a comparison of the resistances of iron and salt water could be made. This comparison Cavendish gave in a paper published 1776, without, however, giving his method of experiment, which lay hidden in unpublished manuscripts for fully a century. His result was that iron conducts 555,555 times better than saturated solution of salt, a result in remarkable agreement with modern galvanometer measurements. In comparing resistances of materials, we must find the resistances of portions which have the same length and the same cross-section. The results given above, connecting the measured resistance of a conductor with its dimensions, enable us to effect this comparison without difficulty. Thus, if r is the resistance of a wire of length l , and cross-section s , the quantity rs/l evidently measures the resistance of a wire of unit length and unit cross section. If the unit length is a centimetre, and the unit area a square centimetre, the quantity which measures

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this resistance is called the *specific resistance* of the material. The substance which has the smallest specific resistance is the best conductor of electricity. The best conductor is silver; but copper is nearly as good. The specific resistance of iron is nearly six times that of copper, and that of mercury nearly 60 times.

In Cavendish's experiment just described, the iron wire acted as a *shunt* in the circuit of jar and body; for the resistance of the iron wire was much less than the resistance of the body. Hence, the discharge through the wire was proportionately greater than the discharge through the body. In a double-branch circuit the current divides itself into two parts, which by Ohm's Law must be directly as the conductivities of the branches. If we put the galvanometer in one of the branches, we may, by adjusting the resistance in the other branch, vary the current in the galvanometer through a very large range, while the total current supplied by the battery remains constant. Let AB be a wire of unit resistance, forming part of a circuit; and let the points AB be connected to the terminals of the galvanometer, whose resistance we shall suppose to be very great compared to the resistance of the wire AB, say, 5,000 ohms. If i is the current as measured on the galvanometer, $5,000 i$ is the electro-

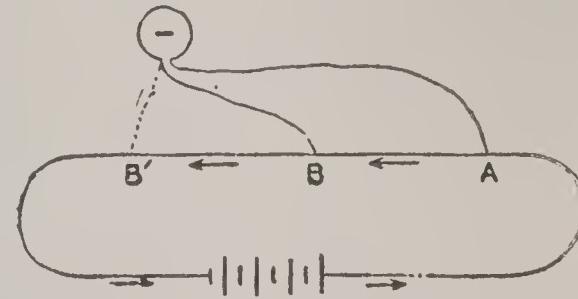


Fig. 22.

motive force acting along AB; and this multiplied by the conductivity of the double-branch portion lying between A and B will give the total current entering at A and leaving at B. The conductivities are 1 and $\frac{1}{5,000}$ respectively, so that $\frac{5,001}{5,000}$ is the conductivity of the whole; and, hence, $5,001i$ is the total current supplied by the battery. Suppose, now, that instead of connecting the galvanometer terminal with B we connect it with B', where BB' represents another ohm of resistance. Then if i' is the current in the galvanometer, we have $5,001i'$ as the electromotive force between A and B'. The conductivity of the double branch portion is now $\frac{1}{2} + \frac{1}{5,000}$, i. e. $\frac{5,002}{10,000}$; hence, the current supplied by the battery is $2,501i'$. But in almost all cases of importance—except when extremely accurate results are wanted—the fourth significant figure in any number is negligible. Indeed, very few galvanometers can be trusted to measure currents to such an extreme of accuracy. Hence, the resistance of the whole circuit is practically the same so far as the possible measurement of current is concerned—i. e., the currents $5,001i$ and $2,501i'$ are equal; and, hence, to the degree of approximation stated $i' = 2i$. In short, the galvanometer of high resistance used in the way just described, in which the main current is shunted through a comparatively small resistance, really measures the electromotive force between the ends of the shunt. For many purposes

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we may use such a high-resistance galvanometer instead of the electrometer.

From what has just been said regarding the accuracy to which a galvanometer deflection may be read, it is evident that if the comparison of resistances depended on the *measurement* of current, it would be impossible to compare resistances to any very great degree of accuracy. The comparison of resistances may, however, be effected by the method known as the Wheatstone bridge, without so much as a single measurement of either electromotive force or current.

Consider the case represented in fig. 23, in which the current from a battery is made to flow along two distinct channels from A to B. Along each the potential falls from its value a at A to its value b at B. Hence, for any point P in the one branch there must be a corresponding point Q in the other which has the same potential, v , say. Let the points

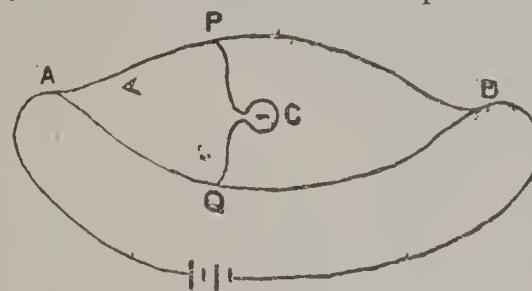


Fig. 23.

P and Q be joined to the terminals of the galvanometer, G. Because of the equality of the potentials at P and Q, no current will flow through the galvanometer, however strong the currents may be in APB and AQB. Thus, as no cur-

rent flows between P and Q, the current in AP must be the same as the current in PB, and the current in AQ must be the same as the current in QB. Hence, by Ohm's Law, the resistances of AP and PB must be proportional to the electromotive forces acting along them—i.e., in the ratio $(a-v)/(v-b)$. Similarly the same ratio expresses the ratio of the resistances of AQ and QB. Thus the existence of no current in the galvanometer circuit—a condition which admits of the most delicate of tests—implies that the resistances of the four branches AP, AQ, PB, QB form a simple proportion, any one forming the fourth proportional to the other three properly taken. Two equal lengths cut off from a fairly uniform wire may be assumed to have approximately equal resistances. Let them be the branches AP, AQ. Let PB be the standard ohm. Then, by adjusting the length QB of a given wire till no current flows through the galvanometer, we obtain a copy of the ohm, accurate if the resistances AP and AQ are really equal to each other. Suppose, however, that they are not quite equal, but that $AP/AQ = 1 + \omega$, where ω is usually a small quantity, and that therefore $AQ/AP = 1/(1 + \omega)$. Let l be the length of wire required in QB when the standard ohm is in PB, so as to satisfy the condition of no current in PQ; and let l' be the length of the same wire required in PB when the standard ohm is in QB, so as to fulfil the same condition. The lengths l and l' will differ so slightly that we may assume them to be accurately proportional to their resistances. If L is the length of wire whose resistance is accurately 1 ohm, then evidently

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$$l = L(1+\omega)^{-1}, \quad l' = L(1+\omega);$$

and hence, multiplying we find

$$ll' = L^2;$$

or the length of wire whose resistance is 1 ohm is the geometric mean between the lengths whose resistances balanced the standard ohm in the two cases described. This discussion is an illustration how, from a first approximation, a second and much closer approximation can be obtained.

To facilitate operations in the measurement of resistance, it is expedient to construct a series of graded resistances, which are multiples and occasionally submultiples of the chosen unit of resistance. We may obtain, in the manner just described, any number of copies of the ohm. Then, by putting two in series in the one arm of the Wheatstone bridge, we can measure off a piece of wire having a resistance of 2 ohms; and so on, step by step, we can measure off lengths of suitable wires whose resistances will be any imaginable number of ohms. Again, by putting in the arms AP, AQ very different resistances, say 10 ohms and 1 ohm, we can construct resistances of fractions of an ohm—e.g., if PB is 1 ohm, QB will be the tenth of an ohm. For such fractional resistances thick wires or many strands of thin wires in multiple are must be used. For the higher resistances thin wires are convenient. Suppose we have, in this way, constructed resistances having the values 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400, 1,000, 2,000, 3,000, 4,000, 10,000, 20,000, 30,000, 40,000; then we may by proper combination express any integral number of ohms from 1 up to 100,000. Thus, the resistance 7.956 is built up of 4,000, 3,000, 400, 300, 200, 40, 10, 4, 2. There are several ways in which these twenty resistances can be arranged so as to admit of rapid combination of any required number. Such an arrangement is called a box of resistance coils, or simply a resistance box. It is an indispensable part of the apparatus of a physical laboratory.

We have already seen that the passage of an electric current means a loss of electric energy. What becomes of this energy—i.e., into what other form is it transformed—is a question which requires to be answered. The answer was fully given by Joule of Manchester, England, in a magnificent series of experiments on the heating effects of electric currents. It was early recognized that the electric current and electric discharge had a heating effect on the conductor along which the current flowed or the discharge took place. As early as 1801, very soon after the discovery of voltaic electricity, Wollaston exhibited before the Royal Soc. the glowing of a thin wire joining the poles of a cell. To Joule, however, we owe the complete statement of the irreversible heating effects of currents. In 1840 he published the important result that 'when a current of voltaic electricity is propagated along a metallic conductor, the heat evolved in a given time is proportional to the resistance of the conductor multiplied by the square of the electric intensity.' The heat so evolved fully accounts for the electric energy lost. Suppose we have an electromotive

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force E driving a current I through a resistance R . E is the measure of the work done in transferring unit of electricity along the channel. Now I is the amount of electricity transferred in a second of time. Hence the product EI measures the work done per second by the electromotive force in driving the current I . But by Ohm's Law

$$EI = RI^2;$$

and this is the very quantity which Joule showed appeared as heat in the wire. Here evidently we have a thermal method for comparing resistances. Set the various conductors in series, so that they are traversed by the same current. Then the resistances are proportional to the heats developed in them. To measure the heats so evolved we must know the rise of temperature and the thermal capacity of each conductor.

If a very thin wire forms a part of a circuit, it is there that we shall best observe the effect of the heating. For the heat evolved per unit length of any conductor is directly as the resistance—i.e., inversely as the cross-section. But, with the circuit all of one material, the rise of temperature is directly as the heat evolved and inversely as the mass heated; and the mass per unit length is directly as the cross-section. Thus the rise of temperature is inversely as the square of the cross-section—i.e., inversely as the fourth power of the diameter.

This is the principle of construction of the incandescent electric lamp, now so common a source of illumination (see ELECTRIC LIGHT). A thin filament of carbon is made to glow by the passage of a powerful current along it. To prevent the 'burning' away of the carbon in air, it is inclosed in a hermetically sealed glass vessel quite empty of oxygen.

As an example of the magnitude of the Joule effect in a conductor of given resistance traversed by a given current, let us take a resistance of 10 ohms, along which the electromotive force is equal to that of one Daniell cell, then the heat evolved in an hour will be about 100 gramme-degree units of heat—i.e., an amount of heat capable of raising the temperature of 100 grammes of water by 1° centigrade.

So long as we are dealing with metals or simple conductors like carbon, the currents derived from the Daniell cells in the circuit do not appreciably change in value from the first instant onward for several hours. If the currents are powerful enough, there will be slight diminution during the first few minutes, due to the heating of the conductors; for the resistance of nearly all metals increases with rise of temperature. But this effect will not in general be appreciable.

A very different set of phenomena confronts us when we introduce into the circuit a conductor like a solution of sulphuric acid, or of any sulphate, or indeed any ordinary chemical compound, either in solution or in a state of fusion. Such conductors can transmit currents only at the expense of their constitution; or, in the words of Faraday, in them 'the power of transmitting the electricity across

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the substance is dependent upon their capability of suffering decomposition.' Such substances—the whole terminology of the subject was introduced in 1834 by Faraday—are called *electrolytes*; the conductors by which the current enters and leaves the electrolyte, the *electrodes*; and the whole process by which chemical compounds are decomposed by means of electric currents is named *electrolysis*.

Take, for example, a dilute solution of sulphuric acid nearly filling a glass vessel. Dip into this electrolyte two platinum strips, some little distance apart and not touching. These are the electrodes, and it is important in such an experiment to choose as electrodes materials for which the electrolyte has no chemical affinity. In this respect platinum is, over all, by far the most satisfactory. Now

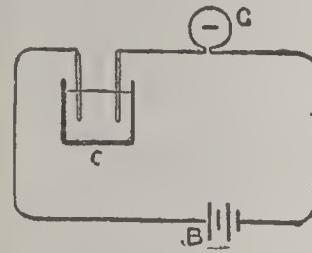


Fig. 24.

connect the one platinum strip to one pole of a Daniell cell, and the other to one of the terminals of the galvanometer. The other terminal of the galvanometer and the other pole of the cell may be connected at will, so as to complete the circuit. When in this way the circuit is completed, a current will be observed flowing

through the galvanometer; but this current will very soon become extremely feeble, and, even though it may not altogether vanish, will produce no continuous decomposition of the fluid. Let now a second Daniell cell be added as shown in fig. 24, where B is the battery of two Daniell cells, G is the galvanometer, and C is the electrolyte. Then the galvanometer will indicate the existence of a pronounced current, which during the first few moments will fall considerably below its original intensity, but will ultimately reach a steady value. At the same time small bubbles of gas will appear at the surfaces of both electrodes, and will form steady ascending streams in the electrolyte. These products, or *ions* as Faraday called them, may be collected in separate vessels, as shown in fig. 27, where the gases accumulate at the top of test-tubes inverted over the electrodes, gradually pushing out the liquid which at first filled these tubes. It will be noticed that the volume of gas given off from the one electrode is twice that given off from the other; so that if the test-tubes are exactly the same size, the one will become quite emptied of liquid when the other is only halfemptied. The greater volume of gas accumulates over the electrode by which the current leaves the electrolyte. When tested, the gas which comes off in greater quantity will be found to be hydrogen, and the other oxygen. In fact we have here separated from one another the constituents of water— H_2O . We may therefore say that whatever the intermediate stages of the process may be, the final result of passing a current through dilute sulphuric acid is to decompose water.

The characteristic points to be noticed here are that one Daniell cell cannot decompose water; that when two or more are used, the current markedly falls off in intensity during the first few moments; and that, when the current

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has become constant, steady streams of bubbles of gas ascend through the liquid from the surfaces of the electrodes, and from them only. These are some of the characteristics peculiar to electrolytic conduction; and, when present, any one of them is sufficient to distinguish an electrolyte from a simple conductor. We shall discuss them more fully in order.

(1) Exactly as one Daniell cell cannot decompose one electrolytic cell of dilute acid, so two Daniell cells cannot decompose two electrolytic cells. Take, for example, a trough filled with dilute acid, and forming with its platinum electrodes one long electrolytic cell, C, which is traversed by a current from two Daniel cells, B. A distinct deflection will be observed on the galvanometer, G, and the ions will be given off at the electrodes. Now let a platinum plate, P (shown dotted in fig. 25), of exactly the breadth of the trough be inserted somewhere between the electrodes, and pushed down till it comes into close contact with the bottom of the cell. Very soon the current will die away, or only a very feeble one will remain, which Von Helmholtz has shown to be due to the presence of free gases dissolved in the electrolyte. There will, however, be no continuous production of ions at the electrodes, even in cases in which this feeble current has not been eliminated. The reason is simply that by so partitioning an electrolytic cell we really make it into two. To obtain distinct decomposition in these two cells we must use four Daniell cells in series; and then we should observe the ions given off not only at the terminal platinum plates, but on both sides of the partition plate. Thus it appears that the process of electrolysis is not merely a question of current, but also a question of electromotive force.

(2) To study more closely the second point indicated, take two platinum strips *p*, *q*, thoroughly cleaned by heating in a flame to bright redness, dip them into the electrolyte, and connect them to the electrometer. The electrodes being both clean, platinum will have the same contact electromotive force with the electrolyte, so that they will be at the same potential. Hence the electrometer will show zero deflection. Now put the electrolytic cell in circuit with the galvanometer and a battery of two or more Daniell cells;

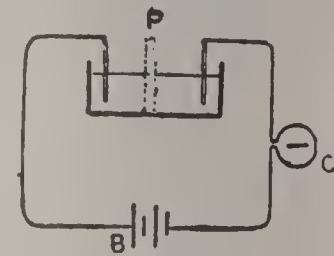


Fig. 25.

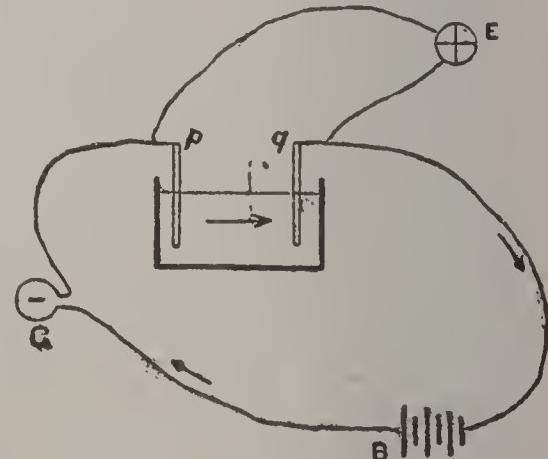


Fig. 26.

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and suppose the current to flow from p to q through the electrolyte. Then it may be observed that, as the current through the galvanometer falls off during the first stages, the difference of potential between p and q as measured on the electrometer increases. If we apply Ohm's Law to the portion between p and q , we see at once that the ratio E/I has considerably increased. This ratio, which for simple conductors measures the resistance, we shall speak of as measuring the Impedance. Impedance in fact is a more general term, synonymous with resistance for steady currents through metals and simple conductors, but including other quite distinguishable properties when electrolytes are the conductors, or when the current is variable. It should be mentioned that during these early changes in current and distribution of potential the temperature of the circuit has not appreciably altered, so that we are precluded from explaining the effect as due to increase of resistance in virtue of rise of temperature.

After the current has become steady, let the circuit be broken. The galvanometer needle will swing back to zero; but the electrometer needle will swing back only a certain distance, and then continue slowly and more slowly back toward zero. Thus, after the current from the battery has ceased to flow, the electrodes in the electrolytic cell remain at different potentials, and will remain so for an indefinite period. This phenomenon is called the Polarization of the Electrodes. From being in a state of electrical identity these electrodes have been brought, simply through the agency of a current, into a condition of electrical dissimilarity. In other words, the electrolytic cell has virtually become a voltaic cell; the electrodes have become poles at different potentials.

Let now the polarized cell be joined up in circuit with the galvanometer—i.e., let a wire be set in where the battery at first was. The electrode p being at a higher potential than the electrode q , a current will flow from p to q through the galvanometer, and from q to p through the cell—i.e., in a direction contrary to the direction of the current which first circulated in the circuit. As this current flows, the deflection on the electrometer will rapidly fall off, until very soon the potentials of p and q will be practically equalized, and the current will disappear. Thus though, because of the polarization of the electrodes, the electrolytic cell has at first all the virtue of a voltaic cell, this virtue is rapidly lost when it is used as a source of current, for there is nothing to sustain it.

In this polarization of the electrodes we have one explanation of the increased impedance of the cell. As soon as the current from an external source begins to pass through, decomposition begins in the electrolyte. The ions accumulate on the platinum electrodes, which become coated with oxygen and hydrogen gases. They are no longer platinum, platinum, dipping in an electrolyte; but oxygenized platinum, hydrogenized platinum, dipping in the same. Of these the latter is eminently oxidizable, just as the zinc is in, say, a simple platinum zinc voltaic cell,

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Hence, the hydrogenized platinum, which is that by which the original current left the electrolyte (q in fig. 26), behaves like the zinc in an ordinary cell, but behaves like the zinc only so long as it is hydrogenized. When, then, the polarized electrolytic cell is included in a circuit otherwise free of electromotive force, a short-lived current will flow at the expense of the electromotive force of polarization, its energy being derived from the reunion with their appropriate associates in the water molecule of the oxygen and hydrogen clinging to the platinum electrodes. We may express the result very simply in symbols, thus: Let E be the electromotive force acting round the circuit, r the resistance of the electrolytic cell *when there is no polarization*, s the resistance of the rest of the circuit (galvanometer, battery, and connections). Then if I be the initial value of the current before polarization sets in, we have, by Ohm's Law,

$$I(r + s) = E.$$

But at once polarization begins, and the reversed electromotive force due to it more or less quickly attains its maximum value e . If J is the final value of the current, we have, by Ohm's Law,

$$J(r + s) = E - e,$$

in which E and r are supposed to be the same as before. Evidently J is less than I . Again, if we write the quantity e in the form jk , where k measures something of the nature of resistance, we may at once transform the equation thus:

$$J(k + r + s) = E.$$

The quantity $(k + r)$ measures the impedance.

The unavoidable production of this reversed electromotive force due to the polarization of the electrodes is a great hindrance in the way of measuring the true resistance of electrolytes. If we put an electrolytic cell into one arm of a Wheatstone bridge, and operate as we do in the case of simple conductors, we should measure the impedance, not the resistance. Suppose, however, that we have in some thoroughly satisfactory manner measured the true resistance, which perhaps might be best defined by Joule's Law in terms of the heating effect of a given current in a portion of the electrolyte far removed from the electrodes, even then we should be in doubt as to the true significance of the rest of the so-called impedance. We see that the electromotive force of polarization explains a part; but does it explain all? Its existence depends on the accumulation of the ions at the electrodes, and it is quite conceivable that the existence of such accumulations may mean an extra resistance in the true sense of the word.

(3) We pass now to the consideration of the ions themselves. As we have seen, the electrolysis of dilute sulphuric acid results in the appearance at the electrodes of oxygen and hydrogen. The oxygen is given off where the current enters the electrolyte, and the hydrogen is given off where the current leaves the electrolyte. A very simple experiment will show that the amount of water decom-

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posed in a given time is proportional to the current as measured on the galvanometer. Suppose, for instance, that with two Daniell cells in the circuit, the test-tube over the negative electrode in the electrolyte fills with hydrogen in 20 minutes. Then, if four Daniell cells are put in circuit, and the external resistances slightly adjusted so as to make the galvanometer indicate double the former current, the test-tube will be filled with hydrogen in 10 minutes. With six cells, and three times the original current, the tube will be filled in $6\frac{2}{3}$ minutes, and so on. Thus we may compare currents by the quantities of a given electrolyte which they decompose in a given time. Faraday's voltameter, as shown in fig. 27, is intended for this purpose. As compared with a galvanometer, the voltameter has the obvious disadvantage that it cannot measure a current at once, but only after the current has been flowing for some time. Hence it measures only the average current during this time; so that unless we know the current to be very constant we cannot draw sure conclusions from the indications of the voltameter. Then, again, there are other sources of error which must be guarded against if anything like accurate results are desired. Thus, in Faraday's voltameter, the gases, as they collect in the test-tubes, are at somewhat diminished pressures in the early stages, so that their volumes do not grow quite proportionately with their masses. But a greater source of error lies in the fact that all the gas given off does not collect in the tubes.

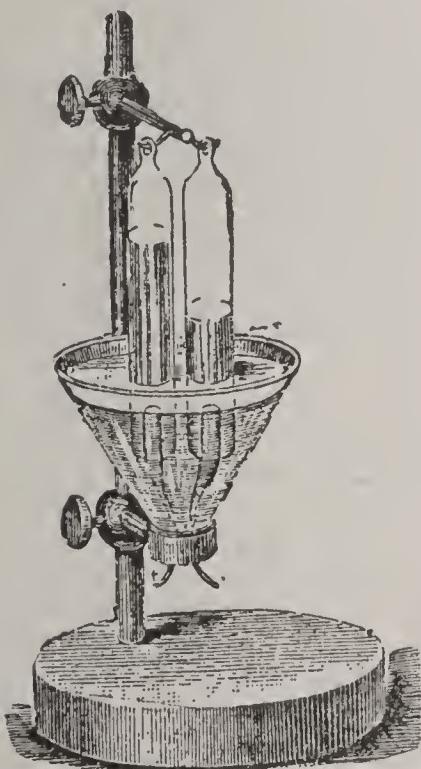


Fig. 27.

Some remains dissolved in the fluid, and this is true specially of the oxygen, which, besides, comes off partly in the denser form of ozone; and some (as the phenomenon of polarization shows) remains clinging to the electrodes. For ordinary purposes, however, the volume of hydrogen given off in a given tube is a fairly accurate measure of the current effecting the decomposition, and may be used for gauging galvanometers —i.e., for finding what deflection corresponds to the chosen unit of current. For that purpose we must know how much water a unit current can decompose. Now, as proved by Faraday, equal currents decompose equal quantities of a given electrolyte in equal times—i.e., wherever and whenever one milligramme of water is decomposed in one minute by a par-

ticular current, that current has a definite absolute value. The numerical measure of it will depend of course on the particular units of length, time, and mass which are

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adopted as the fundamental units (see UNITS). It is evident, then, that electrolysis gives us a means of measuring a current in terms of a quantity of matter decomposed. To obtain absolute measurements of currents with a galvanometer we require to know the magnetic field in which the galvanometer needle hangs, and the dimensions and arrangement of the coils of wire constituting the galvanometer; but for absolute measurements of currents by means of electrolysis we have to do only with measurements of mass.

Now, not only is the amount of any electrolyte decomposed proportional to the strength of current used, but the amounts of different electrolytes decomposed by the same current have a definite numerical relation to one another—a relation which Faraday showed to have a most essential connection with the known laws of chemical combination.

Let us take, e.g., three electrolytic cells—the first, an ordinary voltameter with dilute sulphuric acid as electrolyte; the second, a V-shaped tube containing fused silver chloride with a silver wire for a negative electrode and a piece of carbon for positive electrode; the third, a solution of sulphate of copper with copper electrodes. Let these electrolytic cells be put in series, and a sufficiently strong current passed through them. In the first—the voltameter—oxygen and hydrogen will collect; in the second, chlorine will appear at the carbon, and may be collected, while silver will be deposited on the silver wire; and in the third, copper will be deposited on the negative electrode, while the positive electrode will gradually dissolve away. After the current has flowed for some time, measure the amounts of gases collected, and the amounts of silver and copper deposited. The last two are easily measured by simply weighing the electrodes before and after the process—the increments of mass of the silver and copper which acted as the negative electrodes in the silver and copper salts respectively giving at once the amounts deposited on them. Suppose, for example, that two milligrammes of hydrogen and 16 milligrammes of oxygen have collected in the voltameter; then it will be found that 70·8 milligrammes of chlorine have collected over and on the carbon, 216 milligrammes of silver have been deposited on the silver, and 63 milligrammes of copper on the copper electrode. Now these numbers measure what are called the chemical equivalents of these substances—they are proportional to the quantities which enter into similar combinations. Thus, in hydrochloric acid, for every 2 grammes of hydrogen there are 70·8 grammes of chlorine; in cupric chloride, for every 70·8 grammes of chlorine there are 63 grammes of copper; and so on, through all the related compounds of these substances. See ATOMIC THEORY.

Maxwell has thrown Faraday's fundamental laws of electrolysis into a suggestive form by first defining the electro-chemical equivalent of a substance as that quantity 'which is electrolyzed by a unit of current passing through the substance for a unit of time, or, in other words, by the

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passage of a unit of electricity.' Then the law of electrolysis is that 'the number of electro-chemical equivalents of an electrolyte which are decomposed by the passage of an electric current during a given time is equal to the number of units of electricity which are transferred by the current in the same time.' Now during electrolysis the products of decomposition appear only at the electrodes, and nowhere else. The electrolyte consists in fact of two groups of components, chemically bound together everywhere throughout the liquid. But the steady appearance of the ions at the electrodes shows that the two groups of components must be steadily travelling in opposite directions through the electrolyte. Hence it follows that although these molecular groups are chemically bound together everywhere throughout the liquid, the individual component groups are constantly changing their associates. For example, in the case of the electrolysis of fused silver chloride any individual silver molecule is handed on, so to speak, from chlorine molecule to chlorine molecule till it reaches the negative electrode and is deposited there. At the same time, each individual chlorine molecule passes in the other direction from union with one silver molecule to union with the next, until finally it reaches the positive electrode and becomes free—i.e., there is constant dissociation and recombination going on in the substance of the electrolyte. Clausius (1857) supposes that this process is going on in the liquid at all times; but that, when an electromotive force acts on it, a direction of motion is given to the component molecules in their momentarily free condition, so that they drift, the one set of components with the electric current, the other set against it. The feeblest electromotive force is sufficient to compel a certain drift of ions, which we may suppose to be conveying the current of electricity by a kind of convection through the liquid. When the ions reach the electrodes, they no longer find ions of the opposite kind to combine with, and begin to accumulate on the electrodes. But for this a finite electromotive force is necessary; for with the accumulation of ions on the electrodes a reversed electromotive force—the so-called electromotive force of polarization—begins to show itself. This grows with the accumulation of the ions up to a certain point; and if the external electromotive force is not greater than the electromotive force of polarization so produced, the current will cease to flow, or at least be so enfeebled as to be practically useless in causing electrolysis.

The ions, as they appear at the electrodes, may not be the real components of the electrolyte which are being urged in opposite directions through the liquid. In the case of fused silver chloride, the ions are no doubt these very components; but, in the case of dilute sulphuric acid, we have no right to regard hydrogen and oxygen as the real original products of electrolysis. Indeed, we know by experiment that the purer the water the greater its resistance; so that we have every reason to believe that absolutely pure water is a non-conductor and cannot be elec-

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troyzed. Probably the secondary actions which in the case of dilute acid transform the real original ions into oxygen and hydrogen may be somewhat similar to what is certainly part of the action when a solution of sulphate of soda is electrolyzed. The components of the molecule Na_2SO_4 are Na_2 and SO_4 —i.e., sodium and what is called sulphion. The sodium molecules drift with the current, the sulphion molecules against it. But the sodium, when it appears at the negative electrode, at once acts chemically on the water, forming soda, Na_2O , and liberating hydrogen, H_2 . Again at the positive electrode, the sulphion not being able to exist in the free state, breaks up into SO_3 and O ; and then the sulphuric acid is dissolved up in the water, and oxygen is given off. Thus, again, the constituents of water, H_2O , appear as the ions, exactly as in the case of the dilute acid. Here, however, the molecule of the electrolyte is not really Na_2SO_4 , but has so much water united with it. Thus there may be a direct decomposition of water, as well as of the sulphate of soda. Whatever the real process of electrolysis, it is certain that in many cases secondary chemical actions quite mask it. These secondary actions do not, however, affect the accuracy of the law of electrolysis. Whatever be the apparent products of decomposition, these, if they can be caught and measured, will appear in quantities proportional to their chemical equivalents. It is further evident that if one electrochemical equivalent of an electrolyte is decomposed, it must be decomposed into components chemically equivalent to one another and to it. Hence it is enough to measure carefully the electro-chemical equivalent of one of the ions or products of decomposition. By means of a table of chemical equivalents we shall then be able to calculate the electro-chemical equivalents of given electrolytes. So many are the causes, both physical and chemical, which tend to disturb the perfect accumulation of the ions on or over the electrodes, that the accurate experimental determination of the electro-chemical equivalent is very difficult. Large copper electrodes in copper sulphate yield fairly good results; but the only completely satisfactory combination is a particular solution of nitrate of silver with pure silver electrodes. The electrolysis of this electrolyte by means of a current, whose strength should be adjusted to the size of the electrodes, so as to give a particular amount of current per unit area, is accompanied by an accurate transference of so much silver from one electrode to the other. In other words, the one electrode loses as much as the other gains, a degree of perfection which is hardly ever attained in other cases. Recent independent determinations by Kohlrausch and Rayleigh agree to the fourth significant figure; so that we may safely say that the unit of current known as the ampère will reduce out of a solution of nitrate of silver 1·118 milligrammes of silver per second. This therefore is the electro-chemical equivalent of silver. Now in chemical combinations 216 grammes of silver correspond to 18 grammes of water and to 65 grammes of zinc. Hence a simple calculation gives .0932 milligrammes as the elec-

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tro-chemical equivalent of water, and .336 milligrammes as the electro-chemical equivalent of zinc.

The unit of current above mentioned, the ampère, is one-tenth of the electro-magnetic unit of current, which may be defined in several ways (see MAGNETISM). For our present purpose, however, it is sufficient to indicate experimentally what magnitude of current the ampère is. If an ampère is passing along a conductor of 1 ohm resistance—say, a column of mercury 106 centimetres long and 1 square millimetre cross-section—the electromotive force along the conductor—i.e., the difference of potential of its ends—will be the quantity known as 1 volt; and the volt is such that the electromotive force of a Daniell cell is about 1.08 volts. In connection with electric lighting, these units—the volt, the ampère, and the ohm—are in universal use.

Intimately connected with electrolysis is the theory of action of the ordinary galvanic or voltaic cell. For, whenever such cells are being used for the production of electric currents, there are going on within them chemical actions essentially electrolytic. Take, for example, the Daniell cell with its copper and zinc plates dipping respectively in solutions of copper and zinc sulphates. When the cell is closed, the current flows externally from the copper to the zinc, and internally from the zinc through the zinc and copper sulphates to the copper. The electrolysis of these electrolytes is a necessity, with the result that the zinc is gradually dissolved away, and copper deposited on the copper electrode. The net chemical result is the removal of copper from the sulphate and the substitution of an equivalent of zinc. But this chemical reaction is accompanied by the evolution of heat—i.e., the liberation of so much energy available for transformations. It is this energy which is the source of the electric energy when the replacement of copper by zinc in the sulphate is effected in the particular arrangement known as the Daniell cell. Now, according to Thomson's determinations of heats of combination, the consumption of 1 gramme of zinc in a Daniell cell means the evolution of 8,053 gramme-degrees, that is, an amount of heat that would raise 8,053 grammes of water 1° C. in temperature. Hence the consumption of an electro-chemical equivalent of zinc—i.e., .336 milligrammes—means the evolution of 2.706 gramme-degrees of heat. This then is the energy which is associated with the production of one unit of electricity. To reduce it to dynamic units we must multiply by the factor 4.2×10^7 , which is the number of units of energy equivalent to the heat required to raise the temperature of 1 gramme of water 1° C. Thus we find 1.14×10^8 as the energy which a Daniell cell liberates per second when it produces a current of one ampère. If E is the electromotive force associated with this unit current, then E measures the work done per second by the current; and assuming that this is the energy liberated in the cell, we find $E = 1.14 \times 10^8$ electro-magnetic (C. G. S.) units of electromotive force—i.e., 1.14 volts, according to the definition of a volt. This is slightly higher than the real value of the electromotive force of a Daniell cell, but it is close

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enough to warrant the conclusion, first enunciated by Sir William Thomson (1851), that the electromotive force of any electro-chemical apparatus is, in absolute measure, equal to the dynamical equivalent of the chemical action that takes place during the passage of unit current for unit time. There are many cases of galvanic combinations for which this principle fails to a degree which cannot be even approximately referred to errors of experiment. Some other principles, either chemical or physical, must be involved. There is no question, however, as to the general application of the law enunciated by Thomson.

We are now able to see why it is that one Daniell cell cannot effect an electrolysis in which the constituents of water appear as the ions. It is simply because the heat developed in the formation of an equivalent of water by direct union of its constituents is about half as great again as the heat evolved in the combustion of an equivalent of zinc in a Daniell cell. Hence, to decompose an electro-chemical equivalent of water requires more energy than is supplied by the combustion of an electro-chemical equivalent of zinc in the cell.

The general principle here indicated may be stated thus: A current i flowing through a given electrolyte decomposes i electro-chemical equivalents in unit time. But this requires a definite amount of work done, which we may write ie , where e measures the work which must be done to decompose one electro-chemical equivalent. Hence the energy of the current must be *at least* ei , or in other words, e measures in absolute measure the smallest electromotive force with which distinct electrolysis can be effected.

All the phenomena which accompany simple electrolysis are encountered in the action of galvanic cells. The poles, like the electrodes, become, or tend to become, polarized. This is especially the case in single fluid cells, in which the apparent electromotive force very markedly diminishes during the first few moments of action, due to the reversed electromotive force of polarization produced by the accumulation of the ions on the poles. In the so-called constant elements, such as the Daniell, the Bunsen, or the Grove, all of which are double-fluid cells, the ion is either of the same nature as the pole at which it appears, or is dissolved in the fluid so as not to accumulate. By such means the electromotive force is kept fairly constant so long as the strengths or characters of the solutions do not greatly alter. The chief conditions to be fulfilled by cells which are to yield strong, steady currents are (1) small polarization, (2) a plentiful supply of electrolyte, (3) a small resistance. This last condition is obtained by using large surfaces for the electrodes, which are opposed to each other as closely as the arrangements of the cell will permit.

The difficulties of measuring the true resistance of electrolytes, and therefore of galvanic cells, have already been touched upon. We must here confine ourselves to the chief results which experiment has established. As compared with metallic conductors, the specific resistance of electrolytes is very great. Then, again, rise of tempera-

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ture diminishes the resistance of electrolytes, whereas, except for selenium, phosphorus, and carbon, it increases the resistance of simple conductors. Finally, in the case of solutions in water of such compounds as sulphuric acid, nitric acid, sulphates, chlorides, nitrates, and so on, there is in general a definite solution which conducts better than any other solution of the same substance—i.e. a definite percentage composition which is associated with a minimum specific resistance. In all cases a condition of infinite resistance is approximated to as the solution is taken weaker and weaker; and in some instances (sulphuric acid, for example) the same condition of infinite resistance is hinted at for infinitely strong solutions—i.e. for the pure non-hydrated substance. Kohlrausch, who has probably worked most extensively at this subject, speculates on the necessity of solution or of mixture of stable chemical compounds before conduction can take place. In other words, such compounds, if absolutely pure, would be non-conductors.

We cannot hope to understand the true nature of resistance till we know what an electric current really is. The fact that electrolytes obey Ohm's Law as accurately as simple conductors suggests that the process of conduction is essentially the same in both, notwithstanding the many differences that exist in the accompanying phenomena. The view that an electric current is intermittent—i.e., is a succession of distinct discharges at extremely short intervals of time, is one which seems to be involved in all the best theories of electrolysis that have been elaborated. Maxwell has shown that a rapid intermittent charging and discharging can give rise to all the effects of a true resistance. Suppose we have a condenser of capacity C , whose plates are, by means of a tuning-fork interrupter, alternately brought into contact with the poles of a battery and with each other, so that the condenser is charged and discharged n times a second. If E is the electromotive force of the battery, EC is the electricity which passes at each discharge. Hence in one second ECn units of electricity pass; and this is the current I . Thus

$$I = ECn,$$

so that Cn measures the conductivity. The greater n is, the greater the conductivity, the less the resistance. Hence, if the electric current is of the nature of intermolecular discharge, we see that greater closeness of the molecules, being in all probability associated with more rapid charging and discharging, will give rise to less resistance. This would so far explain the much greater resistance of electrolytes as compared with metallic conductors. For a very complete statement of this view, consult Professor J. J. Thomson's *Applications of Dynamics to Physics and Chemistry* (1888).

The hypothesis just given of the intermittent character of electric conduction obviously suggests that the mode by which electric transference takes place in simple conductors, electrolytes, and dielectrics is fundamentally the

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same. In many dielectrics the phenomenon of 'leakage'—the name given to the gradual loss in charge of a conductor in contact with the dielectric—presents characteristics very similar to true ohmic conduction. Then dry glass, though a very good insulator at ordinary temperatures, becomes distinctly conducting at temperatures above 200° C.—a fact first noticed by Cavendish. Later experiments indicate that the conduction of hot glass is electrolytic, the electrodes becoming polarized. In the case of gases, electrical discharge seems always to be of an intermittent character. A certain electromotive force, depending on the shape and size of the electrodes, on their distance apart, and on the density, temperature, and nature of the gas, is necessary before discharge takes place. For smaller electromotive forces, the gas, if free from convection currents, seems to insulate perfectly. The insulating power of the gas under given conditions is measured by its dielectric strength, which varies as the square of the electric force. The dielectric strength increases markedly for very small distances between the electrodes, a very remarkable fact which may possibly be due to a greater density of gas close to the surfaces of the electrodes. For smaller and smaller distances such condensed layers would of course play a more pronounced rôle. This explanation agrees with the fact that the dielectric strength of gases diminishes as the density is diminished. This, however, does not go on indefinitely, but it reaches a minimum for a certain low density, which has a different value for each gas, and which is also a function of the diameter of the tube in which the rarefied gas is contained. A pressure of 2 or 3 millimetres of mercury gives the density for which the dielectric strength of air reaches its minimum. Further rarefaction beyond the point of minimum dielectric strength is accompanied by a rapid increase of insulating power, until at length it is impossible to make a discharge pass through the extremely attenuated gas. It thus appears that electricity cannot pass from electrode to electrode in a perfect vacuum—i.e. a region void of ordinary matter. Whether this is due to an infinite passage resistance between the electrodes and the so-called vacuum, or to the absolute non-conducting power of the vacuum, is a point not yet settled. Electric discharge through rarefied gases is accompanied by very beautiful luminous effects, which are often enhanced by the phosphorescence of the glass forming the vacuum tubes. These tubes are usually called Geissler tubes, after the first great maker of them (the glass-blower and mechanician, Heinrich Geissler, 1814–79). Into their many curious properties we cannot here enter.

The polarization of the electrodes during electrolysis has within the last ten years acquired great practical importance in connection with the construction of secondary batteries or accumulators. An accumulator is simply a polarized electrolytic cell capable of supplying a steady current for a lengthened time. Theoretically of course, all polarized electrolytic cells are accumulators; but usually the

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currents they supply are short-lived and feeble. It was not till 1860 that Planté constructed an accumulator which could supply a really efficient current. The Planté secondary cell is formed by the electrolysis of dilute acid with lead electrodes. With sufficiently strong currents, the result of the electrolysis is that the positive electrode becomes covered with peroxide of lead (PbO_2), while lead accumulates in a spongy form on the negative electrode. When the polarization has been carried on to a sufficient extent, the cell is said to be charged, and it will be found to have all the properties of a true galvanic cell of low resistance and fairly high electromotive force (about 2 volts). On being closed, it will supply a current sufficient to keep a thin wire glowing for several hours. At the same time, the peroxide of lead will become reduced to a lower oxide, and the spongy lead will be oxidized, while the sulphuric acid present gives rise to other reactions. During the greater part of the discharge of the cell, the electromotive force remains very constant, and only begins to diminish as the depolarization approaches completion. When the charged cell has thus, through use, lost nearly all its accumulated electrical energy, it is put into circuit with a primary source of current energy, and recharged. The modifications of construction introduced by Faure 1881 gave a great impulse to the development of accumulators as a practical source of electrical energy. Instead of using merely lead sheets as electrodes, Faure covers them first with a layer of minium or red lead. With these as electrodes, the electrolysis of dilute sulphuric acid is effected, the result being, as before, the formation of peroxide of lead at the positive electrode and spongy lead at the negative electrode. What chemical reactions take place as the accumulator discharges itself are not fully understood. The final result, however, seems to be the formation of sulphate of lead on both electrodes. Recharging from a prime source restores the peroxide of lead and the spongy lead as in the first charging. As part of the recent development in electric lighting, the efficiency of accumulators has been greatly increased; and they are now largely used as the direct source of power. They must of course be charged and recharged at intervals depending upon the particular rate at which they are made to give off their stored-up energy. A battery of Bunsen or other cells may be used for charging purposes; but if the wasteful voltaic cell had been our only prime source of electric energy, the secondary cell could never have assumed the practical importance it has. It is because we can generate electric energy dynamically and economically (see MAGNETISM) that we find a use for the accumulator, which is simply an arrangement for the storage of so much electrical energy in a form convenient for future purposes.

Of all the thermal effects produced by currents, the Joule Effect is the most conspicuous and by far the most important. But there are other thermal effects which are associated with the transference of electricity, and which are readily distinguished from the Joule effect by what is

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known as their reversible character. Thus the Joule effect always means a rise of temperature in the conductor whatever the direction of the current through it; whereas these so-called reversible effects mean a rise of temperature when the current passes in the one direction, and a fall when it passes in the other. If at any part of a circuit, in which a current is flowing, a fall of temperature is observed, we are probably safe in regarding this cooling effect as one of these reversible effects. We may test this directly by reversing the current; but occasionally the conditions of the experiment may prevent the application of this test. Thus, in some cases, a galvanic cell, in circuit with a large external resistance, is found to cool. Since the current due to a given galvanic combination must always flow in the same direction through the cell, it is impossible of course to apply the test of reversal. Other galvanic cells, again, when similarly joined up with a high external resistance, are found to rise in temperature under conditions in which the true Joule effect is inappreciable. Such thermal effects seem to be true reversible effects; and on them Von Helmholtz bases his explanation of the apparent failure, in many instances, of Thomson's dynamical theory of the electromotive force of a battery (see above). In most cases the electromotive force is smaller than what the chemical reactions imply; but in some it is greater. In the former there is intrinsic heating in the cell; in the latter there is cooling—exactly the relations which the principles of energy require. For, as in the latter case, if the electrical energy generated is greater than the *chemical* energy supplied, it must borrow heat from the surrounding substances to make up its surplus energy. The further fact that those cells, which either heat or cool of themselves, have electromotive forces which vary with temperature, points to these being truly reversible thermal effects. An electromotive force which grows with temperature is associated with a cooling effect in the cell as the current is flowing, while an electromotive force which diminishes with rise of temperature is associated with a heating effect. This must be so; for in all cases of transformations of energy, the final effects react so as to resist the changes that lead to them. In the present case, if a heating effect coexisted with an electromotive force which increased with temperature, this heating effect would raise the temperature still further, increase the electromotive force still more, and cause a stronger current to flow, which in its turn would cause a further rise of temperature, and so on indefinitely—an obvious contradiction of all experience. We shall find some simple applications of the same dynamic principle of reaction in the other reversible thermal effects of electric currents. These are intimately connected with the whole subject of thermo-electricity, which we shall now discuss.

Thermo-electricity dates from 1821, when Seebeck discovered that a current was generated in a circuit composed of copper and antimony, when the junctions were at different temperatures. With a sufficiently delicate galvanometer, the same phenomenon may be shown not

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only with any two different metals, but also with the same metal in two different conditions. Thus, a stretched, twisted, or (if possible) magnetized wire will give thermo-electric currents with a piece of the same wire which has not been so treated. Slight impurities cause distinct changes in thermo-electric properties; indeed, thermo-electric currents may often be obtained in a circuit of two wires, which no other physical test can differentiate. The fundamental fact of thermo-electricity is that, in a circuit built of two or more different conductors, a current is in general generated when one junction at least differs in temperature from the others. For the sake of definiteness, consider a circuit of the two metals

iron and copper, with their junctions at A and B, and with a delicate galvanometer included for the measurement of current. If A and B are at different temperatures, a current will in general be set up in the circuit; and for moderate temperatures up to 250° C or so, this current will flow from copper to iron through the warmer junction, and from iron to copper through the colder

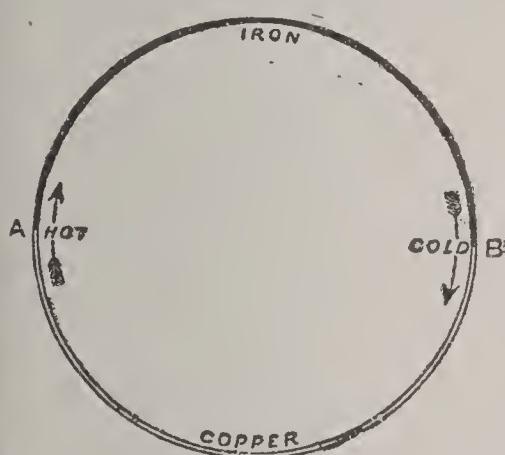


Fig. 28.

junction. Now this current i must derive its energy, ei , from some source; and the only source that exists is the heat which is available in virtue of the unequal distribution of temperature. In virtue of thermal conduction and radiation, the tendency is toward an equalization of temperature, the warmer junction losing heat, and perhaps the colder junction gaining heat. But if this heat is also being partly drawn upon to sustain an electric current, the equalization of temperature will be hastened because of this transformation into electric energy. Hence we should expect the thermo-electric current to be associated with, at any rate, a cooling effect at the warmer junction. That such an effect really does exist was established experimentally in 1834 by Peltier—hence the name Peltier Effect. He showed that heat is absorbed or evolved at the junction of two different metals, across which any current is made to pass; and that if the direction of this current is the same as that of the thermo-electric current that would be produced by heating the junction, the effect is absorption of heat—i.e., cooling; and *vice versa*. Thus, in a copper-iron circuit at moderate temperatures, the thermo-electric current is associated with a cooling effect at the warmer junction, and a heating effect at the colder junction. Icilius proved by experiment (1853) that the Peltier effect is proportional to the strength of the current. It is also known to vary with the temperature, sometimes increasing with rise of

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temperature, sometimes diminishing, according to the particular kinds of metals used.

The Peltier effect is defined as the heat absorbed by the passage of unit of electricity in the proper direction across the junction; or otherwise, the heat absorbed per second by the passage of unit current. Let p be the Peltier effect at the warmer junction of a thermo-electric circuit, and p' its value at the other junction. Assuming that the Joule and Peltier effects are the only thermal accompaniments of a thermo-electric current i , we find for the whole amount of heat absorbed the quantity pi , and for the whole amount of heat evolved $p'i + ri^2$, where r is the resistance of the circuit, and where the heats are estimated in dynamic units. If we suppose these to be the only transformations of energy involved, we have at once

$$pi = p'i + ri^2, \text{ or } p - p' = ri.$$

In the latter equation, the difference of the Peltier effects appears as the electromotive force associated with the current i . From this point of view the Peltier effect is to be regarded as an abrupt change of potential at the junction of the two metals. It must not be confused, however, with the electromotive force of contact discovered by Volta, compared with which it is extremely small, and frequently of opposite sign.

Thus we may suppose thermo-electric currents to be explained in terms of the Peltier effects, regarded as electromotive forces at the junctions. But the striking phenomenon of thermo-electric inversion, discovered by Cumming in 1823, necessitates the supposition of other than Peltier effects for a satisfactory explanation of thermo-electric currents. Take, for example, the copper-iron circuit, keep the one junction B at a steady temperature of, say, 10° C., and raise the temperature of the other junction A steadily and indefinitely from 10° C. to about a dull red heat. As the temperature of A rises, the current setting from copper to iron through A will increase to a maximum, then decrease to zero, and finally become reversed. The temperature at which this maximum current is obtained is a definite temperature for a given pair of metals, being quite independent of the temperature of the other junction. It is called the Neutral Point. If the temperature of the one junction is as much above the neutral temperature as the temperature of the other junction is below it, there is no current; and the mean of these two temperatures is the neutral temperature. For copper-iron the neutral point is about 275° C.; for zinc-iron, about 210° C.; for cadmium-iron, about 160° C.; and so on. In the majority of cases, the neutral point, occurring either above or below ordinary ranges of temperature, cannot be easily observed directly; but its position is usually indicated by the manner in which the electromotive force is found to vary with temperature. Now suppose that the one junction A in the copper-iron circuit is kept at the neutral temperature (275° say); then whatever be the temperature of the other junction, whether it is higher or lower than 275° , the direction of the current

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will always be the same—viz., from copper to iron through the junction A. Consider the two cases: (1) B at temperature 270° ; (2) B at temperature 280° . In the first case, if the only reversible thermal effects existing are the Peltier effects at the junctions, then there must be absorption of heat at A (copper to iron), and (if anything) evolution of heat at B (iron to copper). But in the second case the same assumption requires that there must be absorption of heat at B (iron to copper), and (if anything) evolution of heat at A (copper to iron). Now these two statements are incompatible unless there be neither absorption nor evolution of heat at A—i.e., unless the Peltier effect vanish at the neutral point. But this being so, it is at once evident that in the first case there is no absorption of heat at all.

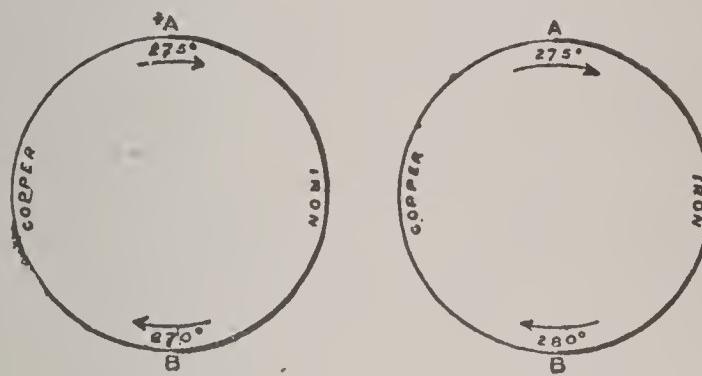


Fig. 29.

Heat is evolved at B, and heat is evolved because of the Joule effect; but there is no evidence of any absorption of heat to account for the energy of the current. Hence the original assumption must be wrong—i.e., there must be other reversible effects in the circuit besides the Peltier effects at the junctions. There must be a cooling effect either in the copper wire, or in the iron wire, or possibly in both. This theoretical conclusion was first obtained by Sir William Thomson (1851), who proceeded at once to test it by an appeal to experiment. It was found that both of these predicted effects take place. A current passing from cold to hot in copper is associated with an absorption of heat; while heat is evolved if the current passes from hot to cold. On the other hand, for iron, things are just reversed; cooling is associated with the current that flows from hot to cold, and heating with the current that flows from cold to hot. This reversible thermal effect which accompanies the passage of a current in an unequally heated conductor is called the Thomson Effect. It is said to be positive in copper; and is therefore negative in iron. Cadmium, zinc, silver, gold, nickel between the temperatures of 250° C. and 310° C., and iron above a dull red heat, have, according to Professor Tait's experiments, their Thomson effects also positive. Platinum, palladium, potassium, sodium, cobalt, nickel below 200° and above 320° , and probably iron again above a bright red heat, are examples of metals having negative Thomson effects. The Thomson effect has been measured directly in a very few

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cases but it may be calculated from thermo electric constants, if Tait's hypothesis be true (and recent direct experiments go far to verify it) that the Thomson effect is for most metals directly as the mean absolute temperature. The extraordinary change of sign in the Thomson effect, which Tait discovered to exist both in nickel and iron at certain temperatures, is an extremely interesting phenomenon, and seems to be connected with other properties peculiar to these magnetic metals—such as their loss of magnetic susceptibility and the manner in which their electrical resistances change with temperature.

In comparison with the electromotive forces of voltaic cells, the electromotive forces that can be obtained with thermo-electric circuits are usually very small. Thus copper-iron with one junction at 275° C., and the other at 0° C., has an electromotive force of only .0022 volts. The electromotive force of an iron-nickel pair with junctions at temperatures 0° C. and 200° C. is .008 volts; and the electromotive force of a bismuth-antimony pair with a difference of temperature of 50° C. is about .005 volts. Bismuth and antimony are, because of their high mutual thermo-electromotive force, ordinarily employed in the construction of the thermopile, a valuable instrument for indicating and measuring small variations of temperature.

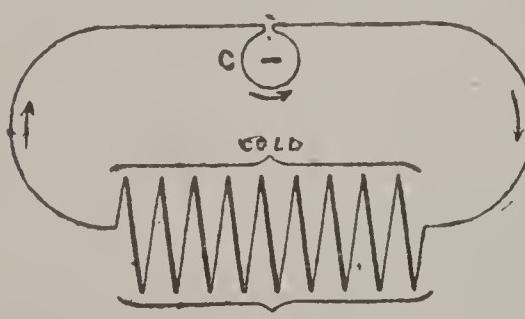


Fig. 30.

It consists of alternate strips of bismuth and antimony forming a continuous zigzag chain, as indicated in figure 30. They are arranged in compact form so that the successive junctions alternate, now on this side, now on that side, forming two plain faces looking opposite ways. If a

source of heat is brought opposite to the one face, the junctions ending there are heated by radiation, while the alternating junctions on the other face remain at the temperature of the air. Each pair of junctions gives rise to a thermo-electromotive force e , and therefore the n pairs to ne . If s is the resistance of each pair of strips, and r the resistance of the galvanometer and connecting wires, the current i is given by the equation

$$i(r + ns) = ne.$$

Thus r is always greater the greater n is; and if, as is usually the case, the resistance of the thermopile (ns) is small compared with the resistance of the galvanometer, the current due to the n pairs is very nearly n times the current that one pair would give. Thus a thermopile of 36 pairs of junctions will give an electromotive of nearly one-tenth of a volt for a difference of temperature between the faces of 25° C.

The Peltier effect between bismuth and antimony at the ordinary temperature of the air is about 3.14×10^5 per

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ampère per second, estimated in dynamic units—i.e., about .0075 in gramme-degree units of heat. Hence in one minute, a current of one ampère passing from antimony to bismuth will evolve a quantity of heat sufficient to raise a gramme of water nearly half a degree centigrade in temperature. For other ordinary pairs of metals, the Peltier effect is considerably smaller than that just given. Thus for iron-copper at the ordinary temperature of the air, the Peltier effect is about one-seventh of its value for bismuth and antimony.

The Thomson effects are extremely difficult to measure directly. We may, however, get an idea of their magnitudes by calculating them according to Tait's theory from the thermo-electric constants. Suppose, for example, that a current of ten ampères is flowing along an iron or copper wire, whose ends are at 0° C. and 100° C. Then the amounts of heat in gramme-degrees evolved or absorbed per minute are, in iron .224, in copper .044. These numbers are calculated on the assumption that the Thomson effect in lead is nil, an assumption based on the direct experiments of Le Roux.

In recent years an extensive literature bearing on electricity has sprung up. Of elementary text-books fitted for the use of students, we may mention Fleeming Jenkins's *Electricity and Magnetism* (Longmans, Green, and Co.), specially good in the practical experimental part of the subject; Ferguson's *Electricity* (W. & R. Chambers, new edition by Prof. Blyth 1882), perhaps the most consistent of elementary treatises in its adherence to the Faraday conception of electric and magnetic action; Cumming's *Theory of Electricity* (Macmillan & Co. 1876); and Maxwell's *Elementary Treatise on Electricity* (Clarendon Press 1881), unfortunately only a fragment. Of complete treatises, Maxwell's *Electricity and Magnetism* (Clarendon Press 1873; 2d ed. 1881) is the great modern classic on the subject. Prof. Chrystal's article 'Electricity' in *Encyclopædia Britannica* is an admirable and compact exposition of the science up to the date of publication. Wiedemann's *Die Lehre von der Electricität* (4 vols. 1882-85) is invaluable as a book of reference to any one desirous of knowing what has been done on any electrical subject. Mascart and Joubert's *L'Electricité et le Magnétisme* (2 vols. 1882-86), translated into English by Dr. Atkinson, has many excellent features which give it a place of its own among other similar works. The development of the modern theory of electricity is traced chiefly through the original writings of Poisson, Ampère, Gauss, Joule, Green, Faraday, Thomson, Maxwell, and Helmholtz; and of these the *Experimental Researches* of Faraday (3 vols. 1839-44-55) will always hold a unique position.—See ELECTRIC: ELECTRO-

ELECTRICITY, ANIMAL: see ELECTRIC FISH.

ELECTRICITY, ATMOSPHERIC: see ATMOSPHERIC ELECTRICITY.

ELECTRICITY, EXECUTION OF THE DEATH SENTENCE BY: see EXECUTION OF THE DEATH SENTENCE.

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ELECTRICITY, MEDICAL. The three forms of electricity—Static, Galvanic, and Faradic—are employed in medicine.

(1) *Static*.—This form has been used little of late years, owing chiefly to the inconvenience and uncertainty of the apparatus required for its production. The old frictional and even the Holtz machines were most uncertain in their action, and depended for their efficiency on various conditions of the atmosphere, etc. The recent invention of the Wimshurst machine is increasing the interest in the use of static electricity for medicinal purposes. This instrument being independent of atmospheric conditions is specially well adapted for occasional use.

(2) *Galvanic*.—The current derived from the galvanic battery is largely employed in medicine. As in almost all cases the current requires to traverse the skin, whose electrical resistance is high, a battery of a considerable number of elements is required to yield sufficient electric pressure. The elements usually employed are some form of the Leclanché or the bichromate element, and batteries containing from 30 to 50 of these are found most convenient. These should yield an electric pressure of from 40 to 70 volts when in good working order. As portability is a consideration, the cells are usually made small, and as the external resistance is considerable and the circuit closed for a comparatively short time, the smallness of the elements is not an objection. When, however, the external resistance is reduced by special appliances, and the current passed for a considerable period, as in the electrolysis of tumors, larger elements must be used, and those of pint or even quart capacity are found convenient. The battery should possess a *collector*, by which the cells may be added to the circuit one by one; and the larger-celled batteries should also possess a *rheostat*, by which the external resistance may be varied with perfect gradations so as to avoid the transmission of shocks while the current is being increased or diminished. Until recently the only measure of the amount of electricity employed was the number of cells in the circuit. This is obviously an unreliable guide. The electromotive force of the cells varies with the exhaustion of the fluid and polarization of the plates, and the resistance of the external circuit varies with the condition of the skin as to moisture, vascularity, and locality, the size, distance between, and the polarization of the electrodes. And as the amount of current passing depends on an absolute relation between the electromotive force and the resistance of the current, neither of which under these conditions can be known, this method is useless. The unit of current strength in ordinary electric measurement is the *ampère*. This is, however, much too large a unit for medical purposes, and the thousandth part of this, termed the *milliampère*, is employed. Galvanometers calibrated in milliampères are now largely made for medical purposes, so that when one of these is introduced into the circuit the exact amount of current passing at a given time can be read directly. As currents varying from 1 to 300 milliampères are now regularly employed, the instrument should be capable of indicating be-

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tween those limits. Further, the instrument should be as near as possible aperiodic (dead-beat). Such an instrument should therefore be included in the circuit whenever it is advisable to estimate the current strength employed. Effects can be compared only when we know the amount of current producing them, and this can be determined only by the milliampère-meter. The efficiency of the current depends, however, not only on its amount, but also on its *density*. This character depends on the diameter of the conductors which bring it in contact with the body. The current-density varies inversely as the sectional area of the conductor. Thus a current of 200 milliampères, conveyed to the body by two conductors whose terminals are 10 inches in diameter, may be borne with little inconvenience and produce little appreciable effect, but if one of the conductors be reduced to, say, 1 inch in diameter while the same current is passing, the density of the current at the electrode is greatly increased, the pain would be intense, and vesication and tissue destruction would follow in a very short time. Currents of large amount and of great density are thus employed in the electrolysis of tumors, etc.

Well-insulated flexible wires of suitable length are employed for conveying the current. These terminate in electrodes, of various kinds and sizes according to the object in view. For ordinary purposes (galvanization of muscle, nerve, etc.) disks, plates, or cones of brass or carbon covered with flannel or wash-leather are employed. For conveyance of large currents, large pads of moist clay, flannel, sponge, etc., 10 or 12 or more inches in diameter, are employed externally, while the current is concentrated by a platinum or steel needle on the part to be affected. In all cases electrodes to be applied to the skin should be thoroughly soaked in a solution of salt in warm water to diminish the resistance of the circuit and the pain of the current.

(3) *Faradic*.—For the production of the faradic current a simple form of induction coil is employed. The primary coil of thick wire is wound round a tube in which slides a bundle of iron wire. The secondary coil of fine wire fits over this. In the best forms of instrument the strength of the current can be regulated both by the sliding of the iron bundle in and out of the primary, and by the sliding of the secondary over, or off and away from the primary. Some form of simple magnetic interrupter (Neef's hammer) is connected with the instrument, and it is desirable that some means should be provided for regulating the rate of interruption. It must be borne in mind that at each movement of the interrupter two currents are generated in the secondary, the one, at the moment of making of the primary, in the opposite direction, and the other, at the moment of breaking, in the same direction as the primary current. The currents from a faradic machine are thus alternating. But further, these differ in strength; the breaking current being reinforced by the 'extra stream' of the primary is considerably the stronger. The signs + and — sometimes marked on the terminals of the secondary refer only to this stronger or breaking current.

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Physiological Effects of the Galvanic Current: (a) *On Sensory Surfaces.*—When a current of from 10 to 15 milliamperes is applied to the skin by electrodes of 1 or 2 inches in diameter, a prickling followed by a burning sensation is experienced. If the current is gradually diminished and the electrodes removed, the skin will be found to be bright red, showing increased vascularity. While the current is being diminished it will be noticed that the sensation first disappears under the positive pole, and while being increased first appears at the negative one, thus indicating the greater exciting effect of the latter. (b) *On Motor Apparatus.*—If a large sponge electrode be applied to the spine in the dorsal region, and a smaller conical one be applied to such a muscle as the biceps in the upper arm, it will be found that if a current of sufficient strength be employed, the muscle will be thrown in contraction at the moment of making and breaking the current. The strength of current required to produce this effect will depend (1) on the pole applied to the muscle; (2) on whether the current is made or broken. In a state of health it is found that muscular contraction occurs with those conditions in the following order: (1) Current closed—negative muscle; (2) current closed—positive on muscle; (3) current opened—positive on muscle; (4) current opened—negative on muscle. Thus the weakest current capable of producing contraction will act when the current is closed with the negative on the muscle (1); and stronger currents will be required to produce contraction under the conditions 2, 3, 4. Or conversely, if a muscle contracts with an opening current, the negative being on the muscle (4), more and more powerful contractions will be obtained by altering the conditions with the same current to 3, 2, and 1.

Electrolytic Effects.—If a broad surface-electrode be applied to any part of the body and connected to one pole, and the other pole connected to a platinum or steel needle inserted into, say, a fibroid tumor of the uterus, or applied to any mucous surface, and a current of 15 to 250 milliamperes passed, tissue in contact with the electrodes will be decomposed. Owing to the extent of the external electrode and small density of the current, the result here will be inappreciable, but it is very obvious at the internal one. Thus, if the electrode is positive, the products of decomposition will be strongly acid in reaction (turning litmus red), and the tissue round the electrode will be condensed, and contract round it. If the internal electrode is now negative, the products of decomposition will be strongly alkaline in reaction, and the tissue will be rapidly broken up, a loose frothy material escaping from the electrode, which will move freely in a sinus formed by the electrolysis. The negative pole while liberating alkaline products has much more marked disintegrating influence than the positive.

Physiological Effect of Induced Currents: (a) *On Sensory Apparatus.*—When a weak current from the secondary is applied to the skin, the sensation is that of gentle prickling or tingling. As the strength of the current is increased, the sensation becomes more and more painful, but has never

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the burning character of the galvanic current. (b) *On Motor Apparatus*.—If one or both poles are applied to a muscle, and a single shock of sufficient strength sent, a single muscular contraction will be produced. If the shocks are repeated with sufficient slowness, a series of single contractions will follow; but if the rate of transmission is increased, the muscle will be thrown into a state of tetanus or continued contraction, the effect of one shock not having passed before the next has reached the muscle.

Diagnostic Uses of Electricity.—Galvanic and faradic currents are employed in the diagnosis of various nervous and muscular disorders. In certain diseases of the spinal cord and the cerebro-spinal nerves it is found that the normal phenomena of muscular contraction are much altered. Thus it may be found that a muscle may fail to respond to faradic stimuli of any strength, and yet continue to respond to interrupted galvanic stimuli; and again it may respond to galvanic stimuli in an order different from that indicated in a previous paragraph as normal to health. These abnormal phenomena are termed the ‘reactions of degeneration.’

Therapeutic Uses of Electricity.—Only the most general indications of these can be given. The *static* form is of value in the treatment of various nervous disorders—e.g., old-standing neuralgia, chorea, hemi-anæsthesia, hystero-epilepsy, and hysteria. *Galvanism* is used in acute neuralgias, such as tic-douloureux, sciatica, etc.; in atrophy of muscle following hemiplegia, diabetes, writers’ cramp, etc.; in spinal irritation, chronic myelitis; in the enlarged and stiffened joints of chronic rheumatism and rheumatic arthritis, and in lumbago; in chronic pharyngitis, in glandular laryngitis (clergyman’s sore throat), naso-pharyngeal catarrh, chronic tonsilitis; and in other diseases associated with chronic inflammation and defective nutrition. *Faradism* is employed in general nervous exhaustion associated with insomnia, in functional disorders of the generative organs, in the acute stage of articular rheumatism, giving great relief to the inflamed and painful joints, in incontinence of urine from atony of bladder and sphincter, in irritable and painful prostate, in hysterical aphonia, neurasthenia, etc.

Galvanism in Electrolysis.—Nævi and aneurisms are frequently cured by electrolysis of their contents. Needles insulated to within a quarter of an inch of their points are plunged into the tumor, and through these the current is passed. Coagulation takes place round the needles, and forms a nucleus round which further clotting occurs, resulting in obliteration of the nævus, or strengthening of the walls and filling of the sac in an aneurism. For uterine hemorrhage a current of 100 to 250 milliampères is employed, a thick platinum wire carrying the *positive* current to the mucous membrane of the uterus, a large surface-electrode lying on the abdomen. The positive current is a powerful haemostatic, and properly applied this method checks most cases of hemorrhage. So also fibroid tumors of the uterus are treated by similar high currents applied in the same way. But the disintegrating effect of the negative

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pole is preferred either lying in the uterine cavity or introduced into the substance of the tumor. Various inflammatory conditions both outside and inside the uterus are similarly treated. All these effects depend (1) *on the strength of the current*, which is obtained by the use of a sufficiently large pressure (30 to 40 cells = 40 or 60 volts), and a large surface external electrode which diminishes the resistance of the skin; (2) *on the density of the current* at the part to be affected, which is obtained by the use of an electrode consisting of a small platinum or steel needle.

In conclusion, a word may be said regarding the much advertised 'galvanic' and 'magnetic' belts. There is no doubt that galvanic chains, such as Pulvermacher's, are capable of giving a more or less continuous current of electricity, and it may be that in some cases their use has been followed by benefit. But the irregularity of their action, and the impossibility of directing or controlling the current, render their use entirely haphazard. Moreover, very troublesome ulcerations have been produced in the skin by prolonged contact of the negative pole. On the other hand, there is not the least evidence that the so-called 'magnetic belts' have any influence whatever on the tissues or functions of the body. They consist of pieces of watch-spring, or of crinoline steel, more or less magnetized, sewn between layers of flannel or other material, and adapted to different parts of the body. It has never been shown that even powerful magnets have any influence on the bodily functions, and there is no reason to believe that these appliances are of any use whatever. Any relief from pain which may follow their application is due probably to the heat-conserving property of the flannel or other material in which the bits of steel are sewn.

ELECTRICITY.

ELECTRICITY, THEORY OF: hypothesis, or speculation, on the nature of electricity (see ELECTRICITY, ETC.). The problem is still unsolved. Modern research has, however, indicated the lines along which increasing knowledge will probably lead to the true solution. In the earlier history of this investigation, two theories were prominent—the two-fluid theory of Dufay, and the one-fluid theory of Franklin. According to Dufay matter is pervaded with two highly elastic imponderable electric fluids—one, the vitreous; the other, the resinous. Each of these in a body is supposed to repel it in another body, but to attract the other. Neutral bodies give no evidence of their presence, for they are there neutralized the one by the other; but when by friction or other operation the fluids are separated, each body observes the attractions and repulsions of the fluid it happens to have. According to Franklin, there is only one electric fluid which repels itself, but attracts matter. Friction determines a gain of the fluid to the positive, and a loss to the negative body. In the recent development of electrical science, Faraday's theory of electric induction by contiguous molecules has largely supplanted the earlier theories (See *Electricity*, Chambers's Educational Course, 1867.) Of this recent development there are two aspects, the mathematical and the experimental.

The great advance in the mathematical treatment is due to the explicit introduction of the idea of the potential. This, as far as electrical science is concerned, is due to Green, in whose memoirs (published 1828) is the potential first so named; for though Laplace, in his *Mécanique Céleste*, had already pointed out its properties, yet to him and his immediate successors, it was merely a mathematical function, from which the forces of a system could be easily derived. Green, however, lived before his time. His memoir was not appreciated; and not until his theorems had been re-discovered independently by Gauss (1839), Chasles, Sturm, and (especially) Thomson, was his *Essay on the Application of Mathematical Analysis to the Theories of Electricity and Magnetism* brought before the scientific world (by the last-named physicist, 1845); and since that date the mathematical development of electricity has gone on rapidly along the lines clearly laid down by Green. To Thomson, particularly, is the present advanced state of the subject due; his method of electric images being especially worthy of mention. See his *Reprint of Papers on Electro-statics and Magnetism* (1872).

Meanwhile, in the hands of Faraday, the whole method of regarding electrical phenomena was being revolutionized. The older electricians had looked upon the *charged conductor* as the real seat of electrical action; Faraday was led by his classical researches to the conclusion that this was to be sought for in the *dielectric* or medium separating the conductors. Through this medium, surrounding a given charged body, Faraday imagined lines of electric force drawn. These lines of force he conceived to start perpendicularly from the surface of the body, and to determine the direction, and, by their closeness, the mag-

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titude of the force which would act at any given point upon a small quantity of electricity placed there. Such a region, with its lines of force, Faraday termed an electric field; and, in a precisely similar way, he treated the lines of magnetic force which he imagined to emanate from a magnet. The mathematicians could not at first accept Faraday's view, as they imagined their analysis could be based solely upon the conception of action at a distance, to which Faraday's views are opposed. Doubtless, in the first instance, the equations were established directly upon this hypothesis; but as pointed out in an early paper of Thomson's (see *Reprint*, p. 29), Faraday's conceptions, expressed in appropriate mathematical language, will lead to the same results as far as analysis is concerned. Faraday, indeed, was a mathematician in the truest sense of the word, and his method of representing electrical phenomena, is intrinsically mathematical. But to give appropriate mathematical expression to these conceptions of action through a medium, required the genius of Clerk Maxwell, who, in his classical treatise, *Electricity and Magnetism* (1873), has done more perhaps than any other man to dispel false notions. He gave to Faraday's views a mathematical significance and comprehensiveness scarcely contemplated by that great philosopher himself. Prof. Maxwell's treatment of electrostatic induction, as developed from Faraday's point of view, is lucidly given in the opening chapters of the *Elementary Treatise on Electricity* (1881), left by its author in an unfinished state. In it the idea of the potential is ever present. The notion of equipotential surfaces, with the tubes or lines of force cutting them at right angles, is made to yield, by a simple synthesis, theorems long supposed to be demonstrable only by means of abstruse analysis. Still following the lead of Faraday, Maxwell has, in his larger treatise, elaborated a theory of the *mechanical* action through the dielectric. He has shown that the hypothesis of a tension along the line of force at any point, proportional to the square of the resultant electromotive force at the point, together with an equal pressure in directions at right angles, gives dynamical effects identical with those given by the ordinary theory of action at a distance.

Previous to the discoveries of Faraday relating to the induction of currents, the laws of electro-kinetics had been fully established, and the mathematical treatment given by Ampère. When Faraday's important researches were published, it became expedient to give a satisfactory theory from which these phenomena might be deduced. Weber's theory of the particles of electricity exerting a mutual force depending upon their relative motion, was such an attempt. The mere fact that the laws of induction could be deduced from it, gives the theory no claim to be a physical truth. For Helmholtz and Thomson had demonstrated that Faraday's laws of induction were a necessary consequence of the truth of Ampère's phenomena, taken in conjunction with the principle of the conservation of energy. Weber's hypothesis includes Ampère's, and is at the same time con-

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sistent with the conservation principle; and any other hypothesis satisfying these conditions would necessarily lead to the same results. Now, Weber's hypothesis is essentially one of action at a distance, the conductor carrying the current being the seat of the action; whereas, Faraday always looked beyond the conductor to the surrounding region, and asked himself what was going on there. Thomson early suggested that the kinetic energy of a current was the energy of vortical motions in the space surrounding the conductor; and this idea has been elaborated by Maxwell into his ingenious electro-magnet theory of light. The medium that transmits light is supposed to be the medium through which magnetic and electric action is propagated. One definite result of the theory as developed by Maxwell is, that the sq. root of the specific inductive capacity of a dielectric is equal to its refractive index for light of infinite wave length—a remarkable result, wonderfully borne out by Silow's and Boltzman's experiments. Also, the curious equality between the velocity of light, and the velocity which expresses the ratio of the electrostatic to the electro-magnetic unit of electricity is, to say the least, not unfavorable to the theory. The special hypothesis on which Maxwell bases his electro-magnetic theory of light does not, of course, affect the beautiful manner in which he derives, from the conception of a medium, the dynamical equations of magneto-electric induction. By the application of Lagrange's general equations to the moving system, he develops the known laws of induction and the mechanical action of currents.

The close connection between electricity and magnetism leads to the mention, in conclusion, of the splendid mathematical investigations of Sir William Thomson in the latter subject. Nearly one-half of the *Reprint* is taken up with his papers on magnetism, which, in power and logical sequence, have rarely been equalled. The theory of induction in crystalline and non-crystalline substances, the whole question of magnetic permeability, the distinction between paramagnetic and diamagnetic bodies, the various theoretical distributions of magnetism, the mutual action of magnets, the theory of electro-magnets, may be noted specially, inasmuch as they involve some of the deepest problems yet imagined in physical science.

ELECTRIC LIGHT.

ELECTRIC LIGHT: intense light produced by a current of electricity made to pass between two carbon points slightly separated, or by a current passing through a filament of high resistance, which it heats to red or white heat. The electric light, like light from most other sources, is produced by raising a body to a temperature so high that some of the radiations that it throws out have a wave-length short enough to affect the retina. A slightly heated body gives radiations of long wave-length only; they may be detected, as any radiations may, by their heating effect when they fall on an absorbent surface, but the eye is not sensitive to them. When the body is made hotter, the whole energy of the radiations increases, but the short waves increase in greater proportion than the long waves, and when the temperature is sufficiently raised, the body begins to give out light. So long as the source is just hot enough to be luminous, the light is nearly all red; as the temperature rises, there are added more and more of the other colors, of shorter wave-length, toward the violet end of the spectrum. In the flame of a candle or of a gas-jet, particles of solid carbon form the luminous source: their temperature, which is determined by the condition that they radiate energy as fast as work is done upon them by the process of combustion, is so low as to make the red and yellow constituents of the light preponderate. A higher temperature has the double advantage of giving whiter light, and of giving it accompanied by a smaller proportion of non-luminous infra-red rays, and therefore with less expenditure of energy in proportion to the amount of light produced.

One way of heating a body to a high temperature is by forcing a strong current of electricity to pass through it. The energy expended depends on the strength of the current and on the electromotive force which is required to make it pass, and this energy takes the form of heat. By selecting a conductor which offers considerable resistance to the passage of the current, it is practicable to produce so much heat in a small space that the temperature reached is limited only by the melting or volatilizing of the heated body. In all actual electric lamps, carbon is used, first and mainly because of its great infusibility; secondly, because of its emissive power. Carbon is in fact the luminous body in nearly all sources of artificial light.

Arc Lighting.—The earliest means of applying the electrical current to the production of light was discovered in 1810 by Sir Humphry Davy, who found that when the points of two carbon-rods, to which the terminals of a powerful battery were connected, were brought into contact and then drawn a little way apart, the current continued to pass across the gap, forming what is known as the electric arc. The electric arc (fig. 1) is brilliantly luminous. The points of the carbon-rods become highly incandescent, and in addition the space between them is filled by a sort of flame, or cloud of particles of white-hot carbon. As the temperature of the arc is much higher than that of any ordinary flame, its efficiency as a

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source of light is exceptionally great, and it is specially rich in highly refrangible (or short wavelength) rays. The carbon-points being exposed to the air gradually burn away, and in addition to this there is a transfer of carbon particles across the arc from the positive to the negative rod, which has the effect of making the positive rod waste about twice as fast as the negative rod. The end of the negative rod becomes somewhat pointed, and a crater-like hollow forms on the end of the positive rod. As the points waste away, the arc lengthens, and would presently break and the current would cease to pass if the rods were not pushed nearer together.

Should the arc break, it can be re-established by bringing the rods again into contact, and again drawing them a little way apart. Arc lamps are devices for holding the carbon-rods, so that they are first brought into contact and drawn apart, to establish or 'strike' the arc, and are then 'fed' together, continuously or at short intervals, to prevent the distance between the points from growing too long.

It was not until the development of the Dynamo-electric Machine (q.v.—see also MAGNETISM), for producing the electric current economically on a large scale, that the electric light came to be of commercial importance. Before that, however, various contrivances had been devised for automatically striking the arc and regulating its length. As early as 1847 a lamp was patented in which the carbon-rods were set vertically one over the other, the upper one being held fixed, while the lower rod was fed upward by the intermittent action of clock-work, which came into gear whenever the current across the arc became reduced below a certain limit of strength through the lengthening of the distance between the carbon-points. Similar devices were proposed by Foucault and others; but the first really successful arc lamp was Serrin's, patented 1857, which has not only itself survived, but has had its main features reproduced in many later forms. In 1858 a lamp designed by Duboscq was used to show the electric light, for the first time at sea, from the South Foreland Light-house on the English coast, where the current to feed the lamp was generated by the large magneto-electric machine of Holmes; and this experiment was followed a few years later by the

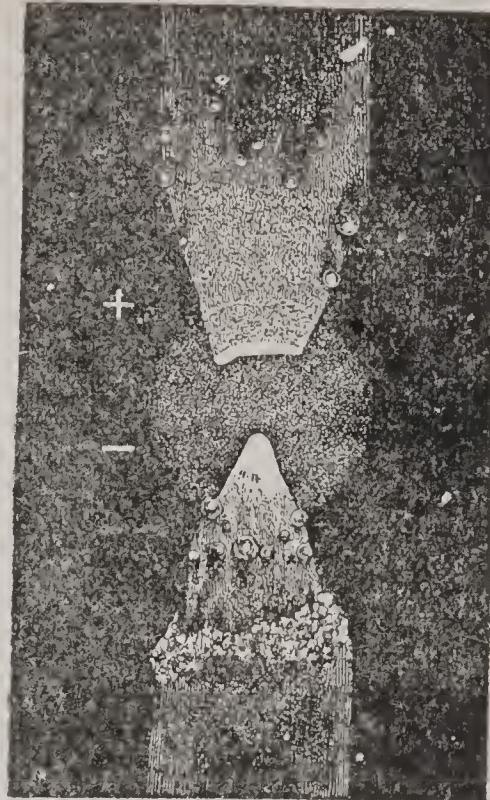


Fig. 1.

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permanent establishment of electric lighting there and at Dungeness and other light-houses. The invention of the self-exciting dynamo 1867 paved the way for the development of electric lighting on a commercial scale. The Jablochkoff candle (1876), in which the arc was formed between the ends of a pair of parallel carbon-rods separated by a layer of insulating material which was slowly consumed as the carbon burned down, did good service in accustoming the public to the new illuminant, and the invention of simple and effective arc lamps by Brush and others brought about its wide adoption 1878-9 for lighting large rooms, streets, and spaces out of doors. In the following year the future of domestic electric lighting was secured by the introduction of the incandescent lamp.

In modern arc lamps, of which there are so many forms that it would be impossible even to classify them in the space here at disposal, the arc is generally struck by the action of the current in an electro-magnet or solenoid, which is connected in series with the carbons, so that, when the current passes, the armature of this magnet is attracted, and its motion is caused to separate the carbons. This sets the lamp in action, and then, as the carbon-points are consumed, the resistance to the passage of the current gradually increases. If the source of electricity is such as to maintain a constant, or nearly constant, difference of potential between the terminals of the lamp, the effect will be that the current will gradually become reduced. On the other hand, if the source is such as to maintain a constant or nearly constant current through the lamp, the effect will be that the difference of potential will increase. Either of these effects may be made use of to regulate the length of the arc. Generally the carbons (which are round rods formed by making powdered coke into a paste and baking it) stand in a vertical line, and the upper one is fixed in a heavy holder, which tends to slide down until the points touch. But its motion downward is checked by a clutch or brake of some kind, which allows it to descend little by little, and only when the length of the arc has become unduly great. Fig. 2 is a skeleton diagram showing the mechanism of Serrin's arc lamp, one of the earliest successful forms. Here the upper carbon-holder, A, has rack teeth on it, which gear into the first of a train of toothed wheels, BC, so that the train must revolve as the carbon descends

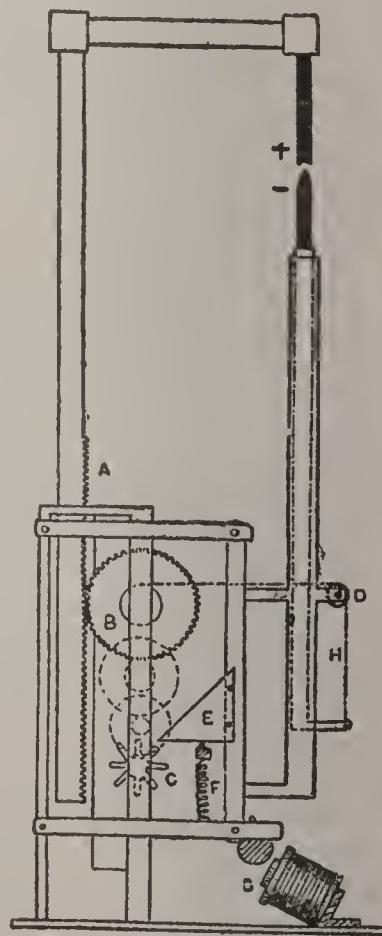


Fig. 2.

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The last wheel in the train, C (which moves much for a very small movement of the holder), is a star-wheel, whose projecting limbs hit or miss a detent, E, the position of which is controlled by an electro-magnet, G, pulling against a spring, F. When the arc is struck, the star-wheel is locked, so that the upper carbon-holder is fixed. As the arc lengthens, the current in the controlling electro-magnet becomes weakened, and this goes on until the detent rises far enough to release the star-wheel. The holder, A, then descends until the current is again strong enough to make the electro-magnet draw the detent down and lock the wheel. Here the control depends on variations in the strength of the current passing across the arc, and the controlling electro-magnet is in series with the carbons (being in fact the magnet which also strikes the arc); if, however, the lamp were to be used with a constant current, the control could easily be effected by variations in the difference of potential between the carbons. The controlling magnet must then form a shunt to the arc itself, and be set so that, when the shunt current in it is weak, the star-wheel is locked and when the shunt current exceeds a certain limit, the detent is raised and the star-wheel is released. The lamp shown in fig. 2 has this peculiarity, that the descent of the upper carbon-holder makes the lower holder rise, through half the distance, by means of the pulley D, and chain H. The effect is to keep the arc burning always at one and the same place, the lower carbon being the negative one, which consumes half as fast as the other. Lamps with this feature are called 'focusing' lamps, and are useful in lanterns where the luminous centre must be maintained in the focus of a lens. For ordinary uses the focusing arrangement is not necessary, and is omitted.

In many modern lamps the controlling electro-magnet is double, consisting of a series and a shunt portion, combined in such a way that the holder is released, and the carbons are caused to approach by either a weakening of the current or an increase of the potential, or both. Such lamps may be used either with constant current or with constant potential.

In place of the train of wheels in Serrin's lamp, a single brake-wheel has been used, turned by a rack on the upper carbon-holder, and stopped or checked by a brake-lever which is pressed against or withdrawn from its circumference by the controlling electro-magnet. Some very successful modern lamps, such as those of Brush and Thomson-Houston, use a still simpler device. The upper carbon-holder slides through a loose collar or ring, which can be tilted by the controlling magnet, so that it clutches the holder. When the current falls or the potential rises, this clutch collar is untilted, so that the holder slips through it and shortens the arc. A dash-pot is employed to prevent the fall of the holder from being too rapid.

When a number of arc lamps are to be used together, they are generally connected in series; a constant current is sent through the group, and the control of the carbons is effected by shunt electro-magnets, taking advantage of

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variations in the difference of potential between the carbons. To prevent the whole group from being extinguished should the feeding mechanism in any one lamp fail to act, a device is added by which any lamp that fails is short-circuited—i.e., the current passes through it by another path. They may, however, be grouped in parallel, if the control is arranged to depend on variations in the strength of the current. Parallel grouping is usual when the lamps are to be served with alternating electric currents.

The rate at which energy is expended in the electric arc is measured by the product of the current and the electro-motive force required to maintain it passing across the gap. If the current be measured in amperes and the electro-motive force in volts, their product gives the rate of expenditure of energy in watts, and may be reduced to horse-power by dividing by 746. It is found that the electro-motive force between the points is nearly constant whether much or little current is passing, which shows that the opposition to the passage of the electric current across the gap is different in kind from the resistance of an ordinary conductor. However short the arc be, it requires an electro-motive force of 30 to 40 volts to maintain it; when the arc is lengthened, the electro-motive force necessary to keep up the same current is increased, but not in proportion to the length. It is found not practicable to maintain the arc with less than a certain strength of current. Hence the power consumed in an arc lamp is necessarily considerable, and the lamp can be employed to advantage only where a large amount of light will be serviceable. The arc lamps most extensively used take from three-quarters to one horse-power, and have an illuminating effect equivalent to something like 1,000 candles. It is impossible to speak with any precision of the candle-power of an arc lamp, because its light differs enormously in color from that of a standard candle. A comparison of the blue rays of the arc with the blue rays of the candle will give a figure nearly three times more favorable to the arc than if the comparison be made between the red rays.

Incandescent Lighting.—In early attempts to produce light by the incandescence of a heated conductor, wire of platinum and of other refractory metals was employed; but these become melted or disintegrated at too low a temperature to let them serve as efficient sources of light. Carbon rods also had been used, but the matter was not brought to a practical issue till 1879, when Mr. Edison (and, almost at the same time, Mr. Swan) made lamps in which the incandescent conductor was a fine thread or filament of carbon inclosed in a glass globe, from which the air was exhausted as completely as possible. The filament was originally formed by carbonizing a thread of paper, cotton, bamboo or other vegetable fibre: it is now made usually by forcing a semi-fluid preparation of cellulose through a die, bending and drying the thread, and heating it to a very high temperature, surrounded with plumbago, in a crucible. The ends of the filament are attached to short conducting wires of platinum, which are sealed into the globe. By making

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the filament longer or shorter, thicker or thinner, the lamp is adapted to be used with more or less electromotive force, and to give more or less light. The lamp has a limited life, for the filament undergoes a slow process of disintegration, which finally breaks it. As in the case of an arc lamp, the power consumed is measured by the product of the current and the electromotive force or difference of potential between the terminal. In ordinary use, incandescent lamps consume three to four watts per candle of light, and last about 1,500 hours. One may force them to a higher efficiency by increasing the electromotive force, so that the temperature of the filament is further raised, and the light is much increased with expenditure of but little additional power. But this shortens the life of the lamp, and tends also to make a deposit of carbon particles on the inside of the glass. The temperature of the filament is in no case so high as that of the electric arc; hence incandescent lighting is less efficient than arc lighting as regards the proportion of light to power, and the color of the light is more yellow. But in point of steadiness and pleasantness, facility for distributing light, and convenience in placing and management, incandescent lamps have many claims to be preferred for indoor use.

An interesting part of the manufacture of lamps is the process of 'flashing' invented by Messrs. Sawyer and Mann, which means the electric heating of the filament for a short time in a hydrocarbon atmosphere. The high temperature of the filament causes the dissociation of the gas in contact with it, and the carbon of the dissociated gas is deposited on the filament. This forms a convenient means of adjusting its thickness and resistance; it also tends to make the filament more uniform, for the process of dissociation and deposit goes on most actively at those places which are thinnest to begin with, and therefore hottest. Incandescent lamps work well with either continuous or alternating currents. They are now made of all sizes, from the miniature lamps of one candle-power or less, which are employed in surgery, up to two or three thousand candle-power. When a number of them are used together, they are almost always grouped in parallel. In the electric lighting of a house, for instance, positive and negative main conductors, consisting of insulated copper wire, are led from the dynamo, and to these the positive and negative branches are respectively connected, whose ramifications extend to every room. Wherever a lamp is to be placed, a positive and a negative leading wire must come, and each lamp forms as it were a bridge between the positive and the negative side of the system. The difference of potential is nearly the same for all; it is a little less in the case of the more distant lamps, because a certain fall in the difference of potential is incurred through the resistance which the leading wires themselves offer to the passage of the current. This loss has to be kept within reasonable limits by making the sectional area of the leading wires great enough, and no serious difficulty is experienced in doing this when the lamps all lie within a few hundred ft. of the source. But

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the difficulty becomes serious when distribution is attempted on a large scale. Not only is the loss of energy in the conductors then a large part of the whole energy supplied, but it may give rise to wider variations in the potential than can be tolerated. If the number of lamps in use in any district were nearly constant, so that a nearly constant current would flow through the mains leading to that district, it would be easy to allow for the fall of potential in those mains. But this fall is itself a variable quantity, depending on amount of the local demand; and to keep the potential sufficiently constant requires mains of large size, the cost of which becomes prohibitory when the area of distribution is much extended.

In such cases it is necessary to resort to other methods of distribution than by a simple system of parallel mains and branches. A sufficient number of sub-centres may be taken over the area to be lighted, and each of these made the starting-point of a system of parallel conductors, the sub-centres themselves being fed from the central source, through independent mains, with currents regulated to produce the necessary potential at each sub-centre. Even then, however, if the sub-centres are widely distant from the source, the loss of energy in the mains will be serious. In distribution over a large area there is an obvious advantage in very high potential, for the same amount of electrical energy is then conveyed by a smaller volume of current, and consequently with less loss in the conductors. This advantage may be secured if the electric energy is conveyed to sub-centres in the form of small currents at a high potential, and converted there into low-potential currents suitable for domestic use. Two plans of doing this have been put in practice—one, by means of storage batteries, is suitable for continuous currents; the other, by means of transformers, is suitable for alternating currents.

Storage Batteries are cells consisting of large sheets or grids of lead, superficially coated with oxide, which are immersed in dilute sulphuric acid, and are polarized by the passage of the current. Peroxide of lead is formed on the positive plates, and spongy metallic lead on the negative. After being charged by the passage of the current, the cells will act for a time as electric generators, giving a current in the opposite direction until the plates again become inactive, when they may be again charged. The electric energy given out when the cells are discharging is somewhat less, but need not, if the cells are slowly charged, be very much less than the energy expended in charging them. Each cell has an electromotive force of about two volts, and its internal resistance is made low by grouping a number of pairs of plates in parallel within a single cell (fig. 3). When such cells are used to convert an electrical supply from high to low potential, they are grouped in series while they are being charged, and the groups are then broken up into sections which may be discharged separately or connected in parallel for discharge. Apart from this use of storage batteries in electric lighting, they form a most valuable, but unfortunately very costly, adjunct in

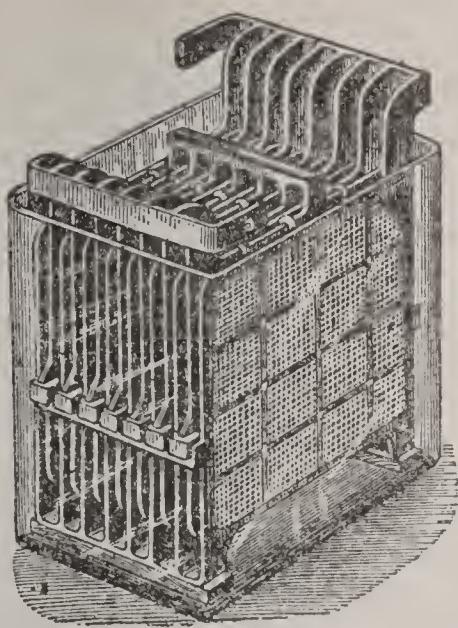
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domestic and other installations, for steadying the electro-

motive force of the supply when used as a shunt across the terminals of the dynamo, and for storing electricity for use during intervals when the dynamo is not running. Small storage batteries have been successfully employed as a means of providing portable electric lamps for use in houses, carriages, and especially in mines. In the new Edison storage battery the heavy lead plates are replaced by thin steel sheets, and the sulphuric acid by a solution of nickel salts. This greatly reduces the weight and bulk of the battery, providing a much greater storage capacity in a limited space. It is

adapted to automobile and electric launch work.

Transformers are induction coils, consisting of a core of soft iron on which two coils of insulated copper-wire are wound. When alternating currents are made to pass through one of these, called the primary coil, they produce corresponding periodic alternations of magnetism in the iron, and induce alternating currents of corresponding period in the other or secondary coil. The effect of the iron is to increase the coefficient of mutual induction between the two coils. When the number of windings in the secondary coil is small compared with the number of windings in the primary coil, the electromotive force induced in it is correspondingly smaller than the electromotive force impressed upon the primary; and this is taken advantage of in practice in the conversion of a high-potential into a low-potential supply for electric lighting. In order that the iron core should have as much magnetic susceptibility as possible, it is made in the shape of a ring or some other closed (poleless) magnetic circuit, and, to prevent waste of energy by the induction of currents in the substance of the iron, the core is laminated by being built up of thin plates or of wire. Even then, however, there is some waste of energy in the core on account of what is called magnetic hysteresis in the periodic changes of magnetism it undergoes, and some further waste occurs through the heating of both the primary and secondary coils, in consequence of the high resistance. This heating is reduced by the use of an oil bath, and the efficiency of a transformer working under favorable conditions is very high, as much as 90 and even 95 per cent. of the energy expended in the primary coil being given off in the converted currents from the secondary. In practice the direc-



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tion of the current is reversed about 150 or 200 times per second.

Distribution of electricity for lighting by means of transformers, high potential being used in the conveyance of the currents from the distant source, with conversion to low potential before use, has been effected on a large scale in many places, especially in the United States, where the system has taken practical shape in the hands of Mr. George Westinghouse. In London the same method has been successfully employed for some years over a wide area by the Grosvenor Gallery Company.

Among minor adjuncts in electric lighting, an important part in guarding against possible risk of fire is played by the 'cut-outs,' whose function is to interrupt the current in any main or branch conductor, should it ever exceed a safe strength—as might happen in the event of an accidental cross-connection or short circuit being formed between the wires. The usual form of cut-out is a safety fuse, consisting of a short piece of foil or wire made of lead or of some fusible alloy which any dangerous excess of current will melt, and so interrupt the current, in that portion of the system which is guarded by the cut-out, before any damage is done. Cut-outs are generally put at the junction of branch with main wires, as well as in the mains themselves. Where the amount of current to be passed is large, an electro-magnetic cut-out is often preferred to a fuse.

Numerous forms of *meter* have been devised for measuring and recording the quantity of electricity supplied to consumers, some suited for continuous currents only, others for alternating as well as continuous currents. Ingenious meters have been invented by Ferranti, Aron, and others. In Edison's meter for continuous currents, which has done good service in central station lighting on the parallel system in New York, the amount of electricity which passes is measured by the deposit of metal in an electrolytic cell. In Forbes's meter, which acts equally well with continuous or alternating currents, the current heats a small coil of wire so that a stream of warm air rises from it; this is made to turn a little wind-mill, whose number of revolutions is registered, and is found to be a good index of the amount of current which has passed.—The literature of electric lighting consists mainly of papers published in the scientific and technical journals, mostly since 1878. For DYNAMO-ELECTRIC MACHINES, see Prof. S. P. Thompson's treatise on *Dynamo-electric Machinery*. A lecture by the same author (*Journal of the Society of Arts*, 1889, March) gives a comprehensive account of various types of arc lamps. Much descriptive and historical matter regarding dynamos and arc lamps is in *Electric Illumination*, by J. Dredge. See also paper by J. Hopkinson, 'On Some Points in Electric Lighting,' *Inst. Civ. Eng. Lectures* (1883); 'On Transformers,' *Proc. Royal Society* (1887); by G. Kapp, 'On Transformers,' *Proc. Soc. of Telegraph. Engineers* (1888), and 'On Alternate Current Machinery,' *Min. Proc. Inst. Civ. Engineers* (1889); by G. Forbes, 'On the Distribution of Electricity,' and 'On Electric Meters,' *Journal of the Society of Arts* (1885, 86, and 89).

ELECTRIC LOOM—ELECTRIC RAILWAY.

ELECTRIC LOOM: ingenious attempt by Bonelli to substitute for the costly perforated cards of a Jacquard loom an endless band of paper covered with tinfoil, on which the required pattern is traced with a varnish, rendering the parts thus covered non-conducting. This band of paper passes under a series of thin metallic teeth, each connected with a small electro-magnet, and these magnets act on a series of small pistons. According as these teeth come in contact with the metallic surface or the varnish, so is a series of holes in a perforated plate closed or opened when an electric current is passing. The perforations in the plate correspond to the punched holes in the cards of a Jacquard, and act in the same way upon its needles. See JACQUARD LOOM: WEAVING.

ELECTRIC RAILWAY: mode of locomotion by means of an electro-magnetic engine. The proposal that electricity should furnish motive power on railways is nearly as old as the railway system itself. In 1837, when it was still doubted whether steam-locomotives would come into general use, an experiment in electric traction was made by Robert Davidson, who propelled a car on the Edinburgh and Glasgow railway, by an electro-magnetic engine, with a galvanic battery to supply the current. But the cost of producing electricity on a large scale by means of a battery is so great as to make such a method of locomotion impracticable, however perfectly the electric energy may afterward be converted into mechanical work; and the electro-magnetic motor of those days could utilize only a small fraction of the electric power supplied. The introduction of the Dynamo-electric Machine (q.v.) gave a cheap means of converting work done by a steam-engine or other prime mover into the electrical form: moreover, it was found that the operation of the dynamo was reversible—that it would serve as a motor, to do mechanical work by the agency of the electric current.

This was demonstrated on a practical scale first at the Berlin Exhibition 1879, by Werner Siemens, who made and worked with complete success a line 219 yards long, on which three carriages, carrying 20 people, ran at a speed of about 7 m. an hour by means of the current from a fixed dynamo driven by a steam-engine. The current reached the car through a special conducting rail placed between the wheel-rails, and insulated from the ground by blocks of wood. The motor on the car took the current from this rail by the rubbing contact of copper brushes, and the circuit was completed through the car-wheels and the ordinary rails. In 1881, at Lichterfelde (Berlin), a simpler plan was employed: the two ordinary rails, insulated from the ground and from each other by wooden sleepers, formed the two conductors. The plan of using the rails themselves as the only conductors is obviously impracticable, except on very short lines and in special circumstances, on account of the difficulty of maintaining good insulation. In some lines a special stiff conducting rail is used,

ELECTRIC RAILWAY.

raised from the ground on insulating supports, as in the Portrush and Bushmills railway in Ireland (opened 1883). In a few cases the conducting rail is put in a trench underground—an arrangement applicable to city street-cars.

All the arrangements for electric traction that have been referred to above are *conductor* systems. Energy is continuously passing to the car through the conductor which maintains connection between the distant dynamo and the motor on the car, and any break of continuity in the conductor, or any failure on the part of the car to make contact with it, deprives the car instantly of locomotive power. The introduction of storage batteries (see ELECTRIC LIGHT) has made a very important alternative method of electric traction practicable—viz., the *storage* system, in which each car or train is self-contained as regards power. In this system there are no conductors along the line, but each locomotive is furnished with a set of storage cells, charged from time to time by means of a station dynamo, and carrying enough energy to last during the trip. The storage system has been put in practice at New York, London, Antwerp, Hamburg, Brussels, and elsewhere; in some cases by placing the cells under the seats of the car, in others by using a separate locomotive-car to carry them and the motor. For city tram-lines its advantages are obvious: it makes each car independent, it causes no obstruction of the street by troughs or posts to carry conductors, and it allows existing lines to be utilized for electric traction without change. Its chief drawbacks are the dead-weight of the batteries and the cost of renewing them when they are worn out or injured by the rather rough treatment that they receive on the road. In conductor and storage systems alike there is considerable loss of energy in the successive transformations, amounting generally to 40 or 50 per cent. On short lines this waste should be less when conductors are used; but on long lines the loss caused by the resistance of the conductors may be greater than the loss which the charging and discharging of a battery entails.

An important feature in conductor methods of electric traction is the possibility that they afford of applying an absolute automatic block system, so as to make it impossible for trains to overtake one another, without any control being exercised from the trains themselves. When the line is divided into sections, it is possible to arrange matters so that the presence of a train on one section has the effect of cutting off the supply of electric energy to the section behind, and thus a train entering the latter finds itself unable to proceed until the train in front has advanced to the section beyond. A number of plans by which this idea may be carried out have been invented. The word *Telpherage* has been proposed as a distinctive name for electric traction developed on these lines.

Telpherage is a system in which the cars are suspended from a cable supported on stout posts about 70 ft. apart, and are driven by electric motors. It is cheaply constructed, and has been at work successfully for a number of years at Glynde, England. It is adapted only for transportation of

ELECTRIC RAILWAY.

freight, ore, etc., in small parcels at low speed. The cars are really suspended tubs, free to swing, and spaced and connected by light coupling rods, and moving at a walking pace without driver. Many ingenious devices are employed to secure the proper running of the cars; the latter are of course without direct supervision as they go on their way.—See PORT-ELECTRIC SYSTEM OF TRANSPORTATION.

The E. R. most used at the present day, as regards structure, is of the single trolley, overhead-wire system. The trolley generally consists of a grooved wheel. It is carried by a long pole, pivoted to a standard on the roof of the car. It is free to swing up and down in a vertical plane. Powerful springs are connected to its butt, so as to tend to raise it into a vertical position. In use it is thus pressed upward against the wire, raking or standing at an inclination of about 45° . Several effects result from this ingenious arrangement. The line-wire can be lowered until it almost touches the roof of the car. This feature is valuable in connection with the passage through low bridges or under other wires and in similar positions. The line-wire, instead of having a trolley of considerable weight, with its depending connecting wire, and the necessary downward pull upon it, to sustain, is actually pushed upward by the pole trolley. This makes a far lighter wire available. The under side of a wire is naturally the freest from the slight obstruction due to dust or other causes. This surface is the one utilized by the pole-trolley system. Although the wheel trolley is generally used, some engineers still advocate the sliding contact.

The single-wire system operates by a ground return, the ground being made through the wheels and rails of the car. The double overhead wire, on continuous metallic circuit, is used in some cases. This necessitates two trolleys, one for each wire, and a more expensive overhead system is required. The parallel system is most in use for the car-motor connections. The line is maintained at a constant potential referred to the return portion of the circuit, and the car-motors, with their connections, are arranged in parallel or like a series of bridges connecting the two branches. Thus the current sent out varies with the number of cars in use, while the potential is constant. Sometimes the series system is used, in which a constant current is maintained, which passes in succession through one car after another, and so returns to the generator. In this case the potential varies with the number of cars in use. A smaller conductor naturally suffices for this system, but a higher potential is needed. One very curious feature of it is that on down-grades the car-motors act as generators or dynamos, and contribute to the maintenance of the current. The action is analogous to that of cars on the two tracks of an inclined plane, the descending car helping to pull up the ascending one.

As regards speed, the great trouble has been to keep it within limits. The motors on street-cars are small and have to be driven at high speed, and the reducing gearing by which their energy is transmitted to the axles of the

ELECTRIC RAILWAY.

wheels, is quickly worn out. By making the axle of the wheel act as the armature shaft, a very high speed has been attained—120 m. an hour recently on an experimental model railroad.

There has been recent successful development of the E. R. in London. A line has been established in a subway, 3 m. long, connecting a southern suburb with the city, and capable of conveying 100 passengers at a time, at speed varying from 13 to 24 m. an hour. In north London, also, on one of the large tramways, a service by secondary batteries has been successfully maintained 1889-90. Underground E. R.s are in operation in Berlin and Paris and in 1903 an extensive subway was under construction in New York. For city transit the overhead-supply system is thus far the cheapest to construct and operate, and most reliable in action, and is installed in all places where popular prejudice against its danger or objection to the inartistic effect of the trolley supports and wires do not forbid its use. Most successful E. R. using an underground current is in Budapest, Hun. Contact with current is obtained through a slit on one of regular rails. Elec. railroading is being extensively applied to long distance inter-urban traffic.

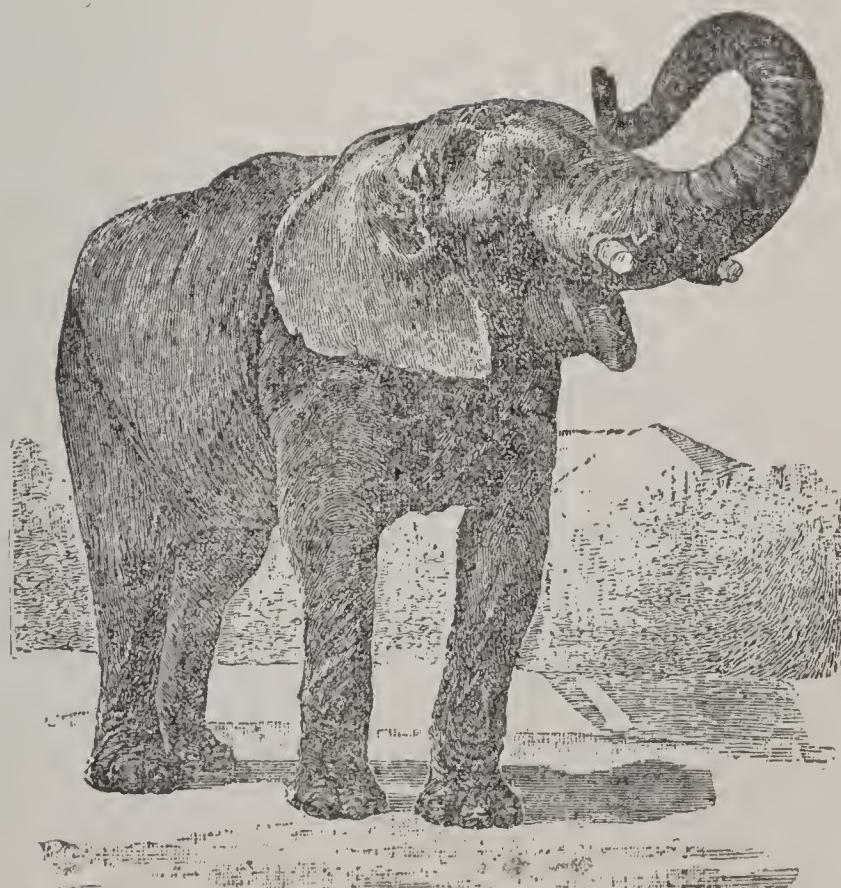
Car motors are in process of evolution, the double reduction motor involving three gear wheels having given way to the single reduction involving two gear wheels, and the latter now finding a competitor in the gearless motor, in which the armature is mounted upon a sleeve loosely surrounding the axle and suitably supported on springs. The gearless motor now coming into use offers the advantage of applying the armature torque directly to the car axle, and the use of the multipolar motors admits of a gearless system being used at ordinary car speeds with a high degree of efficiency. 1892, Oct. 1, there were in operation 469 electric roads, equipped with 7,769 motor cars and 3,790 trail cars, and with over 5,446 m. of track, and carrying annually over a billion passengers. In 1903 there were 22,063 miles of electric railways in operation with an estimated capital stock of \$1,500,000,000. Adaptation of electricity to other than street railways is another sign of progress, for many elevated railroads have adopted such equipment. The decrease in cost of electricity over steam has led to its use for passenger traffic on many steam roads, and postal car service on street railways has proved successful. The equipment of electric roads has reached its highest standard in the U. S. On several inter-urban roads, cars are equipped with Pullman conveniences. The cheap transportation assured by electric railways has greatly increased the building of suburban homes, and opened up country property to a greater extent than any other agency. The anticipated difficulty of mounting grades over 5 per cent. has been disposed of by experience and practice, which show that grades as high as 14 per cent. can be ascended safely and satisfactorily. The use of a pair of cars—a trailer attached behind the motor car—has proved a source of danger to passengers, and of

PLATE 16.

Elbow-pieces
Elephant



Elbow-pieces



African Elephant ('Jumbo').

ELECTRIC TRANSMISSION OF POWER.

wear and tear between the cars, suggesting the desirability of longer cars with double trucks, which are also free from rocking motion, and in several ways less expensive to manage and maintain. The managers of the Lake st. elevated road in Chicago, opened 1897, say that they save \$10,000 a month, in operating expenses, over the steam power cost. Elevated railways of New York are equipped with elec. power. Third rail elec. system has been substituted for the cable cars on Brooklyn Bridge. Baltimore Belt Line plant has added several elec. locomotives to its equipment, and Cincinnati, Hamilton & Dayton R. R. operates its suburban serviee out of Cincinnati by electricity.

ELEC'TRIC SMELT'ING: mode of melting and refin-ing or reducing metals by use of electricity (see IRON : also other metals). The earliest attempt at E. S. was by Sir Wm. Siemens, who showed in his presidential address to the Brit. Assoc., 1882, that an electric furnace might be advantageously used to produce temperatures exceeding the limits (about 1,800 C.) beyond which combustion proceeds very sluggishly. The indications thus given bore fruit in a great enterprise of the Messrs. Cowles, at Cleveland, O., who successfully matured a method for producing aluminium-bronze, ferro-aluminium, and silicon-bronze with the electric furnace. They followed up this with extensive works at Lockport, N. Y., where 18 furnaces are operated for the production of aluminium alloys, the electrical energy being supplied through three dynamo-machines, each giving a current of 3,000 amperes, and worked by water-power, through turbines, each of 500 horse-power. Similar works in n. Staffordshire, Eng., are supplied with a gigantic dynamo-ma-chine, furnishing a current of 5,000 amperes with an electro-motive force of 50 to 60 volts. The arrangements of these furnaces, and their products, are of great interest.

ELECTRIC TELEGRAPH: see TELEGRAPH.

ELEC'TRIC TRANSMIS'SION OF POWER: mode of utilizing water-power by the aid of electricity. The idea was suggested first by a visit made to Niagara, 1876, by Sir Wm. Siemens, and was realized first on a small scale by Lord Armstrong. Some short electric tramways in Ire-land were operated on the plan conceived by Siemens. In the gigantic plants set up at the mines in Nev. and Cal., grand demonstration has been made of the possibilities of this method, whose development promises immense results.

Practical transmission of electric power was long retarded by the fact that the only motor capable of being operated with efficiency by an electric current was the di rect-current motor. Two causes prevented the application of direct current to operate motors at long distances from the source of power, one of which was that the current could not be raised to a sufficient tension or potential fit for transmission over long distances, and the other was that the motor could not utilize a current of such high tension as would be necessary for the transmission of large horse-powers over a small wire; and both these difficulties arose

ELECTRIC TRANSMISSION OF POWER.

from the fact that in generating or utilizing direct current, a commutator is required, which, being composed of a series of separately insulated metallic segments, is subject to the destructive action of sparking and heating. To render transmission over long distances feasible, it seemed necessary to dispense with the commutator or to employ very thick copper conductors. The solution of the problem by thickening the conductors was impracticable, by reason of the excessive cost of the copper; and the minds of inventors were directed to a solution of the difficulty by dispensing with the commutator, so that the tension of the current might be raised. This necessitated the utilization of alternating currents; for dispensing with a commutator necessitates the production of such currents by any known form of dynamo-electric generator capable of yielding adequate strength or tension of current. No difficulty is met in generating such currents; but in operating a motor, an obstacle till 1892 seemingly insurmountable, lay in the low efficiency of alternating current motors. The problem was assailed with energy, with the result that a number of fairly efficient alternating current motors have been produced. The subject was given a great impulse by an experimental plant in Germany exhibited during the Frankfort exhibition, 300 horse-power being transmitted from the Neckar Falls to Frankfort, a distance of 110 m., and there utilized by means of a three phase induction motor. In this system three wires were used, over which were transmitted alternating currents having a period varying from 20 to 40 per second, three sets of alternating currents, differing in phase or time period by 120 degrees, being transmitted over the wires. These phasially different currents were passed through motor windings, which created a rotation of magnetic poles in an iron ring, and an armature provided with a circuit closed on itself revolved within the ring. In this system a line potential of about 20,000 volts was used. The alternating current generated at the Neckar Falls acted on a turbine water-wheel, generating low potential alternating currents of about 50 volts, which passed through a so-called step-up transformer, by which the tension was raised to the line voltage, and at the exhibition was again reduced by a step-down transformer to 100 volts. The power of the waterfall was about 300 horse-power, which was transmitted over a wire about the size of a telegraph wire. A beautifully ingenious transformer of peculiar type was used, by which a multiplicity of alternating currents having a difference of phase were developed from the three currents a third of a period apart, which were carried over the line. The efficiency of the generator was about 90 per cent.; the loss in the line about 6 per cent.; the efficiency of the transformers about 95 per cent. each; and the total efficiency between the axle of the turbine and the motor 74 per cent. One of the great advantages of the motor used in this system was its ability to start under load and to operate at any speed. The armature was polarized by induction from the rotary field, and the amount of this induction increased with the load, so that the capacity of the motor increased as the work it had

ELECTRO-CHEMICAL ORDER.

to do increased. The successful operation of this system gave a lively impetus to operations with alternating currents in the United States. Motors of a similar type had already been planned by Bradley and Tesla. The tests demonstrated that the transmission of water-power to long distances by alternating currents is entirely practicable, and will doubtless, within a very short time, result in the utilization of the power of waterfalls for power and lighting purposes at points distant from such sources of energy. The extensive plant of the Cascade Construction Co., at Niagara Falls, N. Y., in which are turbines with a capacity of 50,000 effective horse-power, is operated under this system. The water is supplied by a canal 1,300 feet long, 100 to 180 ft. wide, and 12 ft. deep. From this it flows through steel shafts or penstocks into turbines of 5,000 horse-power capacity each, set in wheel pits 178 feet deep, from the bottom of which the water flows into the main tunnel 7,000 ft. long, emptying into the river below the falls. In 1903 a similar plant was under construction on the Canadian side, it being proposed to construct 200 m. of electric railway from distances of 25 to 60 m., and to supply electric light and power to the towns and cities along each line, Hamilton, Ontario, being made the centre of the system. Thus far the differential phase-alternating current motor has been the only type capable of meeting commercial conditions. So-called synchronous motors give very high efficiencies, but when overloaded tend to fall out of synchronism and are incapable of restarting unless first brought up by some outside agency to a speed synchronous with the rate of reversal of the alternating current. A motor has been proposed by Messrs. Stanley & Kelly, in which a simple single phase-alternating current is intended to be used. In this motor it is proposed to compensate the lagging effect due to self-induction, which has been the *bete noir* of single circuit-alternating current systems, by introducing the condenser into the field-magnet circuit, which is known to counteract the effects of self-induction.—In St. Etienne, France, electric power is being applied to the operation of hand looms. To grasp the importance of this step it must be understood that the output of ribbons is \$21,000,000 a year as the product of house industry. 18,000 looms are erected in the homes of the weavers, all of which it is proposed to drive by electricity.

ELECTRIC UNITS: see **UNITS, SCIENTIFIC.**

ELECTRIC WELDING: see **WELDING.**

ELECTRO-BALLISTIC APPARATUS: see **VELOCITY, INITIAL:** also **EPROUVENTE: BALLISTIC PENDULUM: GUNNERY.**

ELECTRO-BIOLOGY (term of Animal Electricity): see **ELECTRIC FISH.**—(Term also of Mesmerism): see **HYPNOTISM.**

ELECTRO-CHEMICAL ORDER OF THE ELEMENTS: arrangement of the elements in the order in which they are acted upon by a certain solution. When

ELECTRO-METALLURGY.

two metals are placed in contact and immersed in a solution capable of acting on one of them, an electric current is produced, positive electricity passing from the metal acted on, through the liquid, to the metal unacted on. The former metal is said to be *electro-positive* to the latter. By experimenting with different pairs, we can arrange the metals in electro-chemical order. This order depends upon the readiness with which the metals are acted upon by the solution, and is not the same for all solutions.

The following is the electro-chemical order of the more common metals, the liquid being dilute sulphuric or hydrochloric acid: sodium, magnesium, zinc, iron, copper, silver, platinum. When a compound of two elements is electrolyzed (see ELECTRICITY), the electro-positive element appears at the negative electrode, the electro-negative element at the positive electrode. It is impossible to make a single table of the electro-chemical order of the elements, as this is not the same under all circumstances; but in general oxygen is the most electro-negative element, and next are chlorine, bromine, fluorine, sulphur, etc.

ELECTROCUTION: a barbarous term mistakenly devised to denote execution by electricity: see EXECUTION OF THE DEATH SENTENCE. *Electricution* is a preferable form.

ELECTROL'YSIS: *ě-lék-tról'-i-sis* [Gr. *lektron*, amber, and *lúsis*, setting free]. The resolution of a chemical compound into its elements by the action of a current of electricity passing through it. See ELECTRICITY.

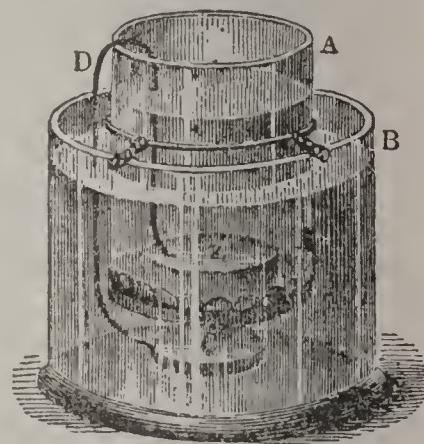
ELECTRO-MAGNETISM: see MAGNETISM.

ELECTRO-MET'ALLURGY: art of depositing, electro-chemically, a coating of metal on a surface prepared to receive it. It may be divided into two great divisions—electrotyping; and electroplating, gilding, etc.; the former including all cases where the coating of metal has to be removed from the surface on which it is deposited, and the latter all cases where the coating remains permanently fixed. Gold, platinum, silver, copper, zinc, tin, lead, cobalt, nickel, can be deposited by electrolysis.

Electrotype is the art of copying printing-type, wood-cuts, seals, medals, engraved plates, ornaments, etc., by means of the galvanic current in metal, especially copper. Suppose we wish to copy a seal in copper; an impression of it is first taken in gutta-percha, sealing-wax, fusible metal, or other substance which takes, when heated, a sharp impression. While the impression—say, in gutta-percha—is still soft, we insert a wire into the side of it. As gutta-percha is not a conductor of electricity, it is necessary to make the side on which the impression is taken conducting; this is done by brushing it over with plumbago by a camel-hair brush. The wire is next attached to the zinc pole of a weakly charged Daniell's cell, and a copper-plate is attached by a wire to the copper pole of the cell; or, as is now usual, the current required is supplied by dynamo-electric machines (see DYNAMO-ELECTRIC MACHINE). When the impression and the copper-plate are dipped into a strong solution of the sulphate of copper, they act as the — and + electrodes. The copper of the

ELECTRO-METALLURGY.

solution begins to deposit itself on the impression, first at the black-leaded surface in the vicinity of the connecting wire; then it gradually creeps over the whole conducting surface. After a day or two on the old method—after a few hours when the magneto-electric is used—the impression is taken out; and the copper deposited on it, which has now formed a moderately strong plate, can be easily removed by inserting the point of a knife between the impression and the edge of the plate. On the side of this plate, next the matrix, we have a perfect copy of the original seal. If a medal or coin is to be taken, we may proceed in the same way, or we may take the medal itself, and lay the copper on it. In the latter case, the first cast, so to speak, that we take of each face is negative, showing depressions where the medal shows relief; but this is taken as the matrix for a second copy, which exactly resembles the original. The adhesion between the two is slight, and they can be easily separated. The cell of a battery is not needed to excite the current. A galvanic pair can be made out of the object to be coated and a piece of zinc. The figure shows how this may be done. B is a glass vessel containing sulphate of copper; A is another, supported on B by a wire frame, and containing a weak solution of sulphuric acid. The glass vessel A is without a bottom, but is closed below by a bladder. A piece of zinc, Z, is put in the sulphuric acid, and a wire, D, coated with insulating varnish, establishes a connection between it and the impression, C, which is laid below the bladder. Electrotype is of the greatest importance in the arts; by means of it duplicates in copper of pages of type are obtained; engraved copper-plates may be multiplied indefinitely, so that proof-impressions need be no rarity; wood-cuts can be converted into copper; bronzes can be copied; and numerous similar applications are made of it. By connecting a copper-plate ready for corrosion with the + pole, and making it a + electrode, it can be etched with more certainty than with the simple acid, and without the acid fumes.



Electroplating.—This is the art of coating the baser metals with silver by the galvanic current. It is one theoretically of great simplicity, but requires for successful application considerable experience and skill. Articles that are electroplated are generally of brass, bronze, copper, or nickel silver: the best electroplated goods are of nickel silver. When Britannia metal, iron, zinc, or lead are electroplated, they must be first electro-coppered, as silver does not adhere to the bare surface of these metals. Great care is taken in cleaning the articles previous to electroplating, for any surface impurity would prevent success. They are first boiled in caustic potash to remove any adhering grease;

ELECTROMETER—ELECTROMOTIVE MACHINE.

they are then immersed in dilute nitric acid to dissolve any rust or oxide that may be formed on the surface, and they are lastly scoured with fine sand. Before being put into the silvering bath, they are washed with nitrate of mercury, which leaves a thin film of mercury on them, and this acts as a cement between the article and the silver. The bath where the electroplating takes place is a large trough of earthenware or other non-conducting substance. It contains a weak solution of cyanide of silver in cyanide of potassium (water, 100 parts; cyanide of potassium, 10 parts; cyanide of silver, 1 part). A plate of silver forms the + electrode; and the articles to be plated, hung by pieces of wire to a metal rod lying across the trough, constitute the — electrode. When the plate is connected with the copper or + pole of a one or more celled galvanic battery, according to the strength required, or subjected to the magneto-electric current, and the rod is joined with the zinc or — pole, chemical decomposition immediately ensues in the bath, the silver of the cyanide begins to deposit itself on the suspended objects, and the cyanogen, liberated at the plate, dissolves it, reforming the cyanide of silver. According, then, as the solution is weakened by the loss of the metal going to form the electro-coating, it is strengthened by the cyanide of silver formed at the plate. The thickness of the plate depends on the time of its immersion. The electric current thus acts as the carrier of the metal of the plate to the objects immersed. In this way, silver becomes perfectly plastic in our hands. We can by this means, without mechanical exertion or the craft of the workman, convert a piece of silver of any shape, however irregular, into a uniform plate, which covers, but in no way defaces, objects of the most complicated and delicate forms. When the plated objects are taken from the bath, they appear dull and white; the dulness is first removed by a small circular brush of brass wire driven by a lathe, and the final polish is given by burnishing. The process of electro-gilding is almost identical with that of electroplating. Success in either is attained by proper attention to the strength of the battery, the strength of the solution, the temperature, and the size of the + electrode. See George Gore's *Electro-metallurgy* (1877) for a sketch of the art—from Wollaston's application of the principle of the voltaic pile to the deposition of one metal upon another (1801), on to subsequent application of that principle by Bessemer (1834), Jacobi (1838), Spencer (1839), and the Elkingtons (1838 onward).

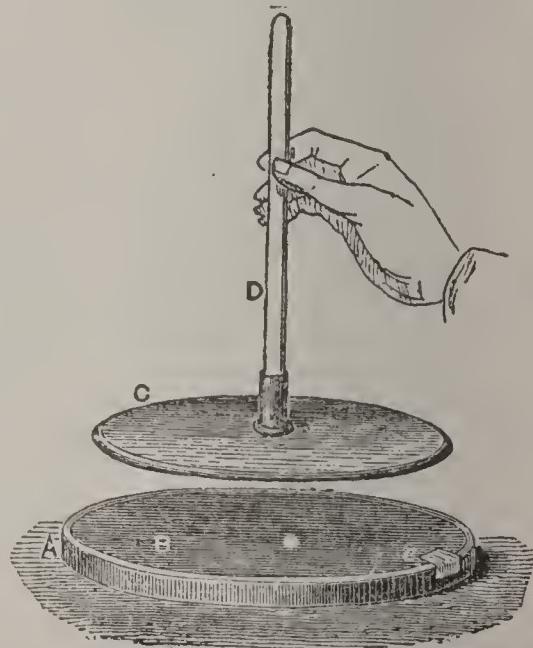
ELECTROM'ETER: see ELECTRICITY.

ELECTROMOTIVE MACHINE: see DYNAMO-ELECTRIC MACHINE: MAGNETISM: ELECTRIC RAILWAY.

ELECTROPHONE—ELECTROPHORUS.

ELECTROPHONE, *ē-lēk' tro-fōn*: apparatus invented by Dr. Strehill Wright about 1864, for making audible to large audiences certain electrical effects. It is essentially a condenser, which, set (for example) in the circuit of a secondary coil, imparts a peculiar tone to the sound of the interrupted current. Apart from its interest in the historical development of the telephone and microphone, the apparatus is of little importance.

ELECTROPH'ORUS: instrument for obtaining electricity by means of induction. It generally consists of a tin mold, A, which in practice is kept in connection with the ground, filled with shellac or resin, B, and a movable metal cover, C, with a glass handle, D, as shown in the fig. The shellac is poured in when melted, and is mixed with some other substance to make it less brittle. When the apparatus is used, the surface of the resin or the shellac is smartly beaten with cat's fur. This electrifies the resin negatively. When the cover is brought near the lower part of the apparatus, it is charged positively on its under surface, negatively on its upper. If then it is touched, the negative escapes, and the cover is charged with + electricity; and if removed and applied to any conductor, it will give a positive charge to it. The process may be repeated for a great number of times with little diminution of B's charge, except by connection or dampness. It is usual to have the earth connection made by a metallic pin passing through B to A, or by a piece of tinfoil, e, pasted extending slightly over B, and connected with A.



Electrophorus.

ELECTROPLATING—ELEGY.

ELECTROPLATING—ELECTROTYPE: see ELECTRO-METALLURGY.

ELECTROTONUS, n. *ē-lēk-trōt'ō-nūs* [Gr. *elektron*, amber; *tonos*, tone]: a physiological phenomenon observed in muscles and nerves on the passage of an electric current. ELECTROTONIC, a. *-tōn'ik*, of or pertaining to.

ELECTUARY, n. *ē-lēk'tū-er-ī* [F. *électuaire*—from mid. L. *electūāriūm*—from Gr. *ek*, out of; *leichō*, I lick]: medicinal preparation in which the remedy is enveloped or suspended in honey or syrup, to make a mixture of thick semi-fluid consistence.

ELEDONE, n. *ēl-ē-dō'ne* [Gr. *heledōnē*, a kind of polypus]: genus of cephalopods, family *Octopodidæ*. Two species are known.

ELEEMOSYNARY, a. *ēl-ē-mōz'ī-nēr-ī* [Gr. *ēlēēmōsūnē*, pity, alms]: relating to charity; given in charity; intended for charitable purposes: N. one living on charity.

ELEGANCE, n. *ēl-ē-gāns*—rarely EL'EGANCY, n. *-gān-sī* [F. *élégance*—from L. *elēgantū*, neatness, refinement—from *er*, out; *lego*, I choose: It. *eleganza*]: polish of manners; propriety; gracefulness; refinement; neatness; beauty or symmetry, applied to writings, speech, buildings, dress, and the like; that which pleases. EL'EGANCIES, plu. *-sīz*, graces or refinements. EL'EGANT, a. *-gānt* [F.—L.]: graceful; refined; beautiful; symmetrical; pleasing to good taste; correct. EL'EGANTLY, ad. *lī*.—SYN. of ‘elegant’: comely; polished; handsome; nice.

ELEGIT, *ē-lē-jīt*, ESTATE BY: right in lands which pertain to one who has acquired the land under Writ of Elegit. ELEGIT, WRIT OF: writ whereby a creditor in England can seize the lands of his debtor in satisfaction of his claim.

ELEGY, n. *ēl-ē-jī* [OF. *elegie*, an elegy—from L. *elegia*; Gr. *elegeia*, an elegy: It. *elegia*]: a song expressing sorrow; a funeral song. ELEGIAC, a. *ēl-ē-jī'āk*, plaintive; expressing sorrow; also EL'EGI'ACAL, a. *-jī'ā-kāl*. ELEGIST, n. *ēl-ē-jīst*, one who writes elegy.—*Elegy*, according to its derivation, signifies, exclusively, a song of lamentation, but the term was employed at an early period by the Greeks to designate any poem written in distiches. The alternation peculiar to this measure, of the hexameter, or strictly narrative verse, with the more fiery pentameter, gives to this whole species of poetry its individual character, which consists in the connection of subjective feelings and emotions with external incidents or objects. The elegy, therefore, can often be chiefly, but never altogether narrative. The effect of the measure is further shown in the fact that earnest, long-sustained feelings, rarely violent passions, are expressed in the elegy. Of the numerous elegies of the Greeks, few have come down to us. Those extant consist partly of encouragements to patriotism, as in Callinus and Tyrtæus, and partly of lessons of practical wisdom, as in Solon and Theognis. Sometimes also the elegy, especially at Alexandria, expressed yearning desire or mild sorrow, or amorous complaints.

ELEMENT.

Among the Romans, Catullus was the first good elegiac writer; after him came Propertius, Tibullus, and Ovid. Tibullus, in particular, brought the erotic elegy to its highest perfection. All are marked by the absence of political or moral feeling. They lived at a time, the Augustan age, when it was dangerous to express the one, and unfashionable to express the other. In modern times, the term elegy is applied to any serious piece where a tone of melancholy pervades the sentiments, whether grief is actually expressed or not; e.g., 'Gray's *Elegy*, written in a country churchyard.'

ELEMENT, n. *ĕl ē-mĕnt* [F. *élément*—from L. *elēmen'tum*, an element; plu. *elēmen'ta*, the first elements of things; It. *elemento*]: a simple substance; the first or constituent principle of anything; an ingredient or constituent part; the proper sphere or state of anything. EL'EMENTS, n. plu. the first rules or principles of any branch of knowledge; rudiments; data; an outline or sketch; the bread and wine used in the Eucharist or Lord's Supper. EL'EMEN'TAL, a. *-mĕn'tăl*, produced by elements; arising from first principles. EL'EMEN'TALLY, ad. *-lĭ*. EL'EMENTAL'ITY, n. *-ĭ-tĭ*, composition; combination of ingredients. EL'EMENTARY, a. *tér-ĭ*, simple; relating to first principles; rudimentary; uncombined; uncompounded; primary. OUT OF ONE'S ELEMENT, in *familiar language*, out of one's proper habitation or sphere; dealing with unfamiliar matters. THE ELEMENTS, in *popular language*, fire, air, earth, and water. ELEMENTARY SUBSTANCES, or CHEMICAL ELEMENTS, in *chem.*, those forms or modifications of matter which have hitherto resisted all attempts to decompose them. The word elements has a very different signification in modern science from what it anciently had. The earliest Greek philosophers assumed either a single element, or several, the modifications and combinations of which they held to give rise to all the things that we see. The most common assumption was that of four elements—fire, air, water, and earth. This corresponds to the four forms under which modern science considers matter as existing—viz., imponderable, gaseous, liquid, and solid; while by elements are now understood the simple component ingredients of bodies under whatever form they exist. Neither air, water, nor earth are elements in this sense, for they can be decomposed into simpler ingredients, and fire is a combination of light and heat. It is not pretended that any of the substances called elements are absolutely simple, i.e., contain only one kind of matter; but only that hitherto they have not been decomposed. The number of so-called simple bodies, or elements, recognized by chemists is 72, of which some have been known from ancient times, such as the metals gold, silver, lead, copper, tin, and mercury; others are of more recent date; during the 20 yrs. prior to 1895, 8 or more new metallic elements were discovered, viz., cæsium and rubidium (by Bunsen), gallium and samarium (Lecoq de Boisbaudran), scandium (Nilson), thulium (Cleve), decipium (Delafontaine), terbium, ytterbium. The year 1895 was notable for the discovery of argon (q.v.) and helium by Lord Rayleigh. The elements are

ELEMENTAL SPIRITS.

divided into two great classes—the *non-metals* and *metals*. The metals are the more numerous class, numbering 57, while the non-metals number 15. The following table gives the names of the elements. For their symbols, etc., see ATOMIC WEIGHTS: CHEMICAL: CHEMISTRY: also see the titles of the various elements.

TABLE OF THE ELEMENTARY SUBSTANCES.

THE COMMON ELEMENTS.

Aluminum.	Fluorine.	Palladium.
Antimony.	Gold.	Phosphorus.
Argon.	Helium.	Platinum.
Arsenic.	Hydrogen.	Potassium.
Barium.	Iodine.	Silicon.
Bismuth.	Iridium.	Silver.
Boron.	Iron.	Sodium.
Bromine.	Lead.	Strontium.
Cadmium.	Lithium.	Sulphur.
Calcium.	Magnesium.	Tin.
Carbon.	Manganese.	Titanium.
Chlorine.	Mercury.	Tungsten.
Chromium.	Nickel.	Vanadium.
Cobalt.	Nitrogen.	Zinc.
Copper.	Oxygen.	

THE RARE ELEMENTS.

Beryllium.	Lanthanum.	Selenium.
Cæsium.	Molybdenum.	Tantalum.
Cerium.	Niobium.	Tellurium.
Didymium.	Osmium.	Thallium.
Erbium.	Rhodium.	Thorium.
Gallium.	Rubidium.	Uranium.
Germanium.	Ruthenium.	Ytterbium.
Glucinum.	Samarium.	Yttrium.
Indium.	Scandium.	Zirconium.

The more rare elements are printed in *italics*. Though the classification adopted above is convenient for the study of the elements, yet there is no decided line of demarkation between the metallic and non-metallic (otherwise called metalloid) series. The metals are generally recognized (1) by their power of reflecting light, as exhibited in the lustre of burnished gold, and even in ordinary mirrors, which owe their power of reflecting light to the amalgam of the metals mercury and tin, present on the glass; (2) by their power of conducting heat; and (3) by their ready transmission of electricity. The non-metals or metalloids are regarded as not possessing all these three attributes. The non-metals carbon and silicon, however, in certain forms conduct electricity, while the metals arsenic and tellurium closely resemble the metalloids in many of their properties. In the combinations of the various elements with each other, the non-metals constitute the electro-negative ingredient, and, as a rule, are insulators in the galvanic current; while the metals form the electro-positive element of the combination, and are conductors of electricity. Again, in their combination with oxygen, the non-metals form more or less powerful acids, while the metals produce more or less powerful bases. At ordinary temperatures, five of the elements are gaseous—viz., oxygen, hydrogen, nitrogen, chlorine, and fluorine; two are liquid—viz., bromine and mercury; while the remaining 57 are solid.

ELEMEN'TAL SPIRITS: beings who, according to the popular belief of the middle ages, presided over the

ELEMENTS—ELEOTRAGUS.

four ‘elements,’ living in and ruling them. The elemental spirits of fire were called Salamanders; those of water, Undines; those of the air, Sylphs; and those of the earth, Gnomes. These imaginary beings play a part in Pope’s mock-heroic poem, *The Rape of the Lock*.

ELEMENTS, in Astronomy: those numerical quantities and those principles deduced from astronomical observations and calculations, which are employed in the construction of tables exhibiting the planetary motions. They include the greatest, least, and mean distances of the planets from the sun, the eccentricities of their orbits, their mean motions, daily and annual, with the motions of their aphelia, and the inclinations of their orbits to the ecliptic; their masses and densities, etc. For the elements of the different planets and of their satellites see their names. For tables of the elements of all bodies in the solar system see the books on astronomy; in particular Herschel’s *Elements of Astronomy*.

ELEMI, n. *él'ě-mi* [F., It., and Sp. *elemi*—probably of oriental origin]: fragrant resinous substance, obtained from different species of the nat. ord. *Amyridaceæ*. It was formerly brought chiefly from Egypt and Nubia, and referred to a tree called the *Amyris elemifera*; now it is obtained also from trees of other genera, but of the same nat. ord., particularly *Icica Icicaiba*, which grows in Brazil and other warm parts of America. In dry weather, incisions are made in the bark, from which the resinous juice flows abundantly, and hardens in the sun. It is collected once a day, and put into casks. It is at first soft and unctuous, but becomes hard and brittle by age. *Elaphrium elemiferum* is believed to yield the greater part of the E. of Mexico. E. is usually in large, pale-yellow, semi-transparent masses, fragile, softening by the heat of the hand, with a smell somewhat resembling that of fennel. It is soluble in alcohol, except a white crystallizable residue called *Elemine*. The properties of E., however, depend chiefly on a volatile oil, which may be obtained from it by distillation. E. is used in the preparation of stimulant plasters and ointments. EL'EMINE, n. -*mīn*, the crystallized and purified resin of elemi; light, inodorous, and tasteless; used to give consistency to the varnish which forms part of the composition of lacquer.

ELENCHUS, n. *ē-lēngk'ūs*, or ELENCH, n. *ē-lēngk'* [Gr. *elenchos*, proof, demonstration]: in *log.*, a vicious or fallacious argument; a sophism; a syllogism which convinces or confutes an antagonist. ELENCHIAL, a. *ē-lēng'ki-äl*, pertaining to.

ELEOCHARIS, n. *ēl-ē-ōk'ér-īs* [Gr. *heleos*, a marsh; *chairō*, I rejoice]: spike-rush, genus of *Cyperaceæ*, tribe *Scirpeæ*. About 118 species are known. The Creeping Spike-rush (*Eleocharis palustris*), is the most common, found in Britain, on the continent of Europe, in n. Africa, n. Asia, western India, and in N. America.

ELEOTRAGUS, n. *ēl-ē-ō-trā'gūs* [Gr. *heleos*, a marsh; *tragos*, a he-goat]: genus of antelopes. *E. arundinaceus* is the Riet-Boc (Reed-buck) of s. Africa.

ELEPHANT.

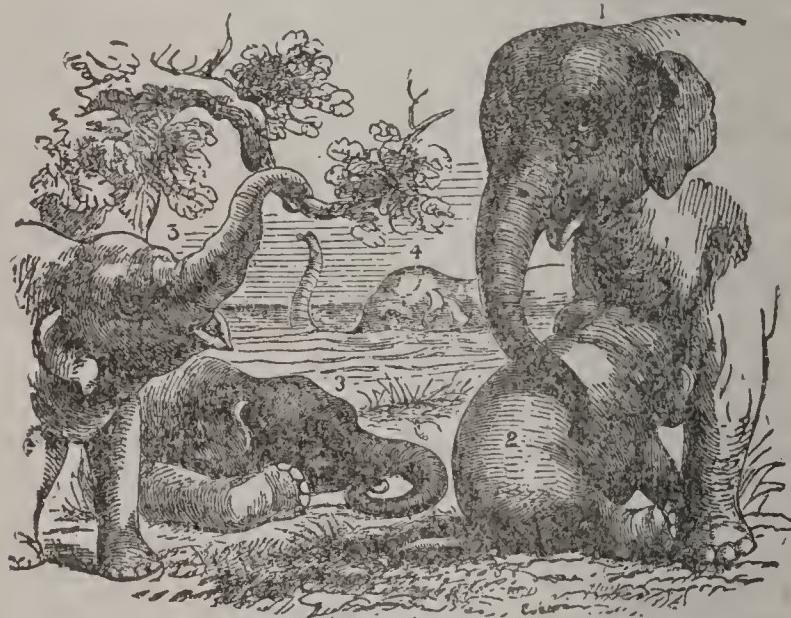
ELEPHANT, n. *él-é-fänt* [F. *éléphant*; OF. *olffant*—from L. *elephantem*, an elephant: It. *elephante*]: the name of a well-known animal. EL'EPHAN'TINE, a. -*fän'tin*, pertaining to; very large. EL'EPHANTI'ASIS, n. -*tī'ā-sīs*, a disease of the skin by which it becomes thick, livid, and insensible to feeling: *Elephantiasis of the Greeks*, see LEPROSY: *Elephantiasis of the Arabs*, see BARBADOES LEG. EL'E-PHAN'TOID, a. -*toyd*, or EL'EPHANTOI'DAL, a. -*toy'däl* [Gr. *eidos*, resemblance]: shaped like an elephant. ELEPHANT'S-FOOT, or tortoise-plant, so called from its peculiar shortened and thickened stem; the *Testudinariū elephan'tipēs*, ord. *Dioscorēacēæ*.

EL'EPHANT (Gr. *Elephas*): genus of quadrupeds, of the order *Pachydermata* (q.v.), section *Proboscidea*. Elephants are the largest existing land animals. The ordinary height at the shoulder is about eight ft., but sometimes exceeds 10 ft. The weight of a large E. is about five tons, the body being very bulky in proportion to its height. To sustain this weight, it is furnished with limbs of colossal thickness and strength, which are also remarkably straight, each bone resting vertically on that beneath it. From the appearance of inflexibility presented by the limbs, arose the notion prevalent among the ancients, and in the middle ages, that the limbs are destitute of joints, and that consequently an E. cannot lie down to rest like another quadruped, and if it were to lie down, could not rise again, but always sleep standing, or leaning against a tree. It is indeed true that the E. often sleeps standing, and when fatigued, falls asleep leaning against a rock or tree, against which it may have been rubbing itself. The flexibility of the limbs is, however, sufficient to permit elephants to run with speed nearly equal to that of a horse, to indulge in playful gambols, and to ascend and descend steep mountains. Elephants are more sure-footed and serviceable than either horses or mules, in difficult mountain roads. On the very steepest declivities, an E. works his way down somewhat rapidly, even with a *howdah* and its occupants upon his back, his chest and belly on the ground, and each fore-foot employed in making a hole for itself, into which the hind foot follows it, and to which the weight may be trusted, that another step may be ventured with safety. In lying down, the E. does not bring his hind-legs under him, like the horse and other quadrupeds, but extends them backward (as man does when he assumes the kneeling position), an arrangement which, 'by enabling him to draw the hind-feet gradually under him, assists him to rise almost without a perceptible effort.' The E.'s pace, when exceeding a walk, is neither a trot nor a gallop, which would be too violent a motion for its conformation and huge body, but a sort of shuffle, the speed of which is increased or diminished without other alteration. The E. is incapable of springing like the deer, horse, and other animals which have the bones of their shoulders and houghs set at an angle.

The head in elephants is large; the neck is short and thick, the long flexible proboscis compensating both for the shortness of the neck, and for the inflexibility caused by the largely developed processes of its vertebræ, and enabling

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the animal readily to reach objects on the ground, or to a height of several feet above its head, or on either side. A great extent of bony surface in the head affords attachment for muscles destined to move and give power to the proboscis or trunk. This extent of bony surface is provided in a remarkable manner, which at the same time makes the head, heavy as it is, lighter in proportion to its bulk than is usual in quadrupeds; a great space separating the internal and external tables of all the bones of the skull, except the occipital bones, so that the space occupied by the brain is but a small part of the whole head. The space between the tables of the bones is occupied by cells, some of which are four or five inches in length; others are small, irregular, and honeycomb-like; these all communicate with each other, and through the frontal sinuses with the cavity of the nose, and also with the tympanum or drum of each ear; consequently, as in some birds, these cells are filled with air.' The huge and extraordinary bones of the skull, be-



Various positions of the Elephant's Trunk:

- 1, female elephant suckling her young one; 2, the young one; 3, elephant reposing; 4, elephant swimming; 5, young elephant browsing.

sides affording attachment for muscles, afford mechanical support to the tusks.

The nasal bones of the E. are scarcely more than rudimentary; but the tapering proboscis, to the very extremity of which the nostrils are prolonged, is nearly eight ft. in length. Besides the great muscles connected with it at its base, it is composed of a vast multitude of small muscles variously interlaced, but chiefly either longitudinal, and divided into successive arcs, of which the convexity is outward, or transverse, and radiating from the internal to the external membrane. Cuvier states the number of muscles having the power of distinct action as not far short of 40,000. The trunk can be coiled around a tree, and employed to tear it from its roots; it is a formidable weapon of offense or defense, and is far more employed in this way than the

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tusks, even by those elephants which have tusks of great size; its extremity can be wound around a small handful of grass or a slender branch; it is even capable of plucking the smallest leaf, or of lifting a pin from the ground. To fit it for such actions as those last mentioned, and for many such as might be performed by a hand, it is furnished at the extremity with what may be likened to a finger and thumb; on the upper side, an elongated process—strong, soft, and flexible, like the rest of the trunk, and endowed with the most delicate sense of touch—on the under side, a kind of tubercle against which this process may be pressed. All the food of the E. is gathered and conveyed to the mouth by the trunk: by means of the trunk, also, it drinks,



1, elephant drinking; 2, elephant gathering long herbage,
3, elephant spouting water over its back.

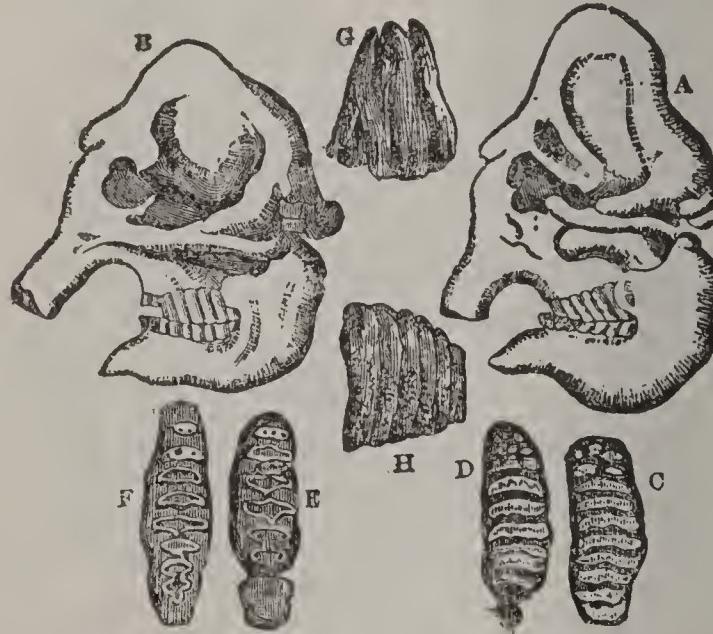
sucking up into it a quantity of water sufficient to fill it, and then discharging the contents into the mouth. Valves at the base of the trunk prevent the water from going too far up the nostrils. The trunk is constantly employed by elephants in providing in many ways for their comfort or enjoyment, as in throwing dust over their backs, or in fanning themselves and switching away flies with a leafy branch, two practices to which they are addicted. Their mutual caresses also are managed by means of the trunk, and through it they make a loud shrill sound, indicative of rage, described by Aristotle as resembling the hoarse sound of a trumpet, and from which this organ received its French name *trompe*, corrupted in English into trunk. With the trunk also, they sometimes, when angry, beat violently on the ground.

The sense of smell is very acute in the E., as is also that of hearing. The ears are large and pendulous, the eyes are small.

Elephants have no canine teeth, nor have they any incisors in the lower jaw. The upper jaw is furnished with

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two incisors, which assume the peculiar character of tusks, and attain an enormous size, a single tusk sometimes weighing 150 or even 300 lbs. The tusks are, however, often imperfectly developed, ten or twelve inches in length, and one or two in diameter. These stunted tusks are often used for such purposes as snapping off small branches and tearing climbing plants from trees. Those elephants which have great tusks employ them also for such other uses as loosening the roots of trees which they cannot otherwise tear from the ground; or in a state of domestication, for such labors as moving great stones, and piling or carrying timber. A powerful E. will raise and carry on his tusks a log of half a ton weight or more. The tusks of the E. surpass in size all other teeth of existing animals, and are the largest of all teeth in proportion to the size of the body. They consist chiefly of that variety of *dentine* called Ivory (q.v.), and continue to grow—like the incisors of the rodents, to which they are in some respects analogous—even when the animal has attained a great age, if not to the



A, skull of Indian elephant; B, skull of African elephant; C, D, upper and lower molar teeth of Indian elephant; E, F, upper and lower molar teeth of African elephant; G, the original state of the grinders when the laminæ of which they consist are as yet unconnected together; H, the laminæ as they are attached in parallels one to the other by cortical substance.

very end of its life. The young E. is at first furnished with deciduous incisors, which are shed between the first and second year, and are succeeded by the permanent tusks.—The molar teeth of the E. are developed in succession; and at least in the Indian E., never more than two are seen in the same side of a jaw at one time. The first molars cut the gum in about two weeks after birth, and are shed about the end of the second year. The sixth molars, believed to be the last, are supposed to appear about the 50th year of the E.'s life. The molar teeth of the E. are remarkable for their great size, and for extreme complexity of structure,

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to which the nearest resemblance is found in some of the small rodents. They are composed of vertical plates of bony substance, separately enveloped with enamel, and cemented together by a third substance, called *crusta petrosa*, *cortical*, or *cement*, resembling bone rather than enamel. Each succeeding tooth is not only more complex, but occupies a greater space in the jaw than its predecessor. Although formed from a single pulp, the molar tooth of an E. resembles an aggregation of teeth; and in the earlier stages of its growth, when the cement is not yet deposited, it seems as if many separate teeth were soldered together. As the surface of the tooth is worn down by mastication, the harder enamel is exposed in elevated ridges. The whole of a tooth is not in employment at once. From the peculiar manner of its growth, the anterior part begins to be used and to be worn away, while the latter part is still in process of formation.

The digestive apparatus of the E. is similar to that of the other pachydermata; but the stomach, which is of a very lengthened and narrow form, exhibits a peculiarity which assimilates it to that of the camel; the internal membrane, at the extremity beyond the cardiac orifice, forming thick wrinkles and folds, the broadest of which, and nearest to the gullet, seems to act as a valve, making that end of the stomach a reservoir for water, capable of containing about ten gallons; while a peculiar muscle, connecting the windpipe and gullet, enables the animal to open this reservoir at pleasure, for the regurgitation of the fluid, which is then sometimes received into the trunk, and squirted over the body, to free it from the nuisance of flies, or the heat of a tropical sun.

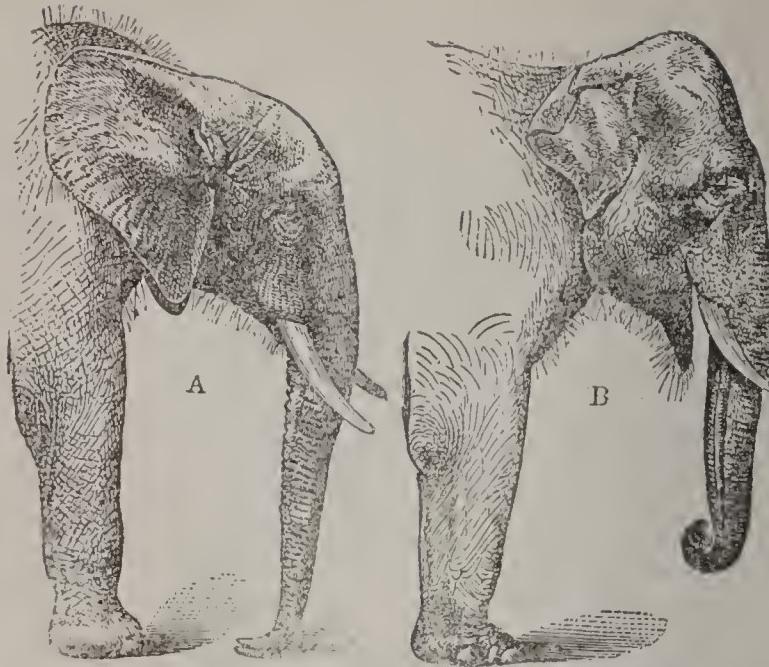
The female E. has only two teats, between the fore-legs. The young suck with the mouth, and not with the trunk. They are suckled for about two years. The period of gestation also is nearly two years, and a single young one is produced at a birth.

The skin of the E. is very thick, of a dark-brown color, and in the existing species, has scarcely any covering of hair. The tail does not reach to the ground, and has a tuft of coarse bristles at the end. The feet have in the skeleton five distinct toes, but these are so surrounded with a firm horny skin, that only the nails are visible externally, as on the margin of a kind of hoof. The foot of the E. is admirably adapted for steep and rough ground, the protective skin which covers the toes allowing them considerable freedom of motion.

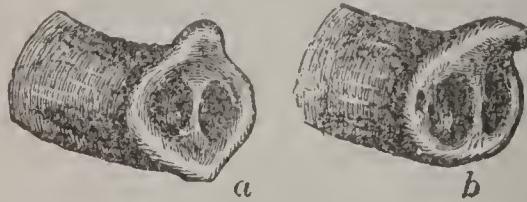
Only two existing species of E. are certainly known, the Indian (*E. Indicus*) and the African (*E. Africanus*), though differences have recently been observed in the E. of Sumatra, which may perhaps entitle it to be ranked as a distinct species. Elephants are found in all parts of Africa, from the Sahara southward, where wood and water are sufficient; also throughout India and s.e. Asia, and in some of the tropical Asiatic islands. They extend northward to the Himalaya; and Chittagong and Tiperah vie with Ceylon in the superior excellence of the elephants which they produce. The Indian E. is distinguished by a comparatively

PLATE 17.

Elephants
Elephanta



Heads of (A) African and (B) Indian Elephants.



Tips of Trunks of (a) African and (b) Indian Elephants.

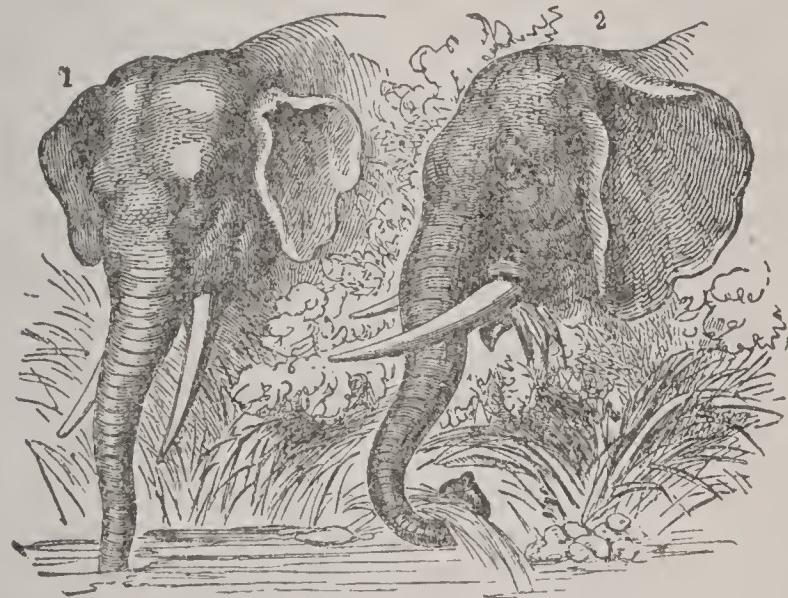


Caves of Elephanta - Maurice.

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high oblong head, with a concave forehead; while the African has a round head and convex forehead. The ears of the African E. are much larger than those of the Indian, covering the whole shoulder, and descending on the legs. A marked distinction of the two species is found also in the molar teeth; those of the Indian E. exhibiting *wavy parallel transverse ridges*; while those of the African species have the divisions of the crown of the tooth fewer, broader, and *lozenge-shaped*.

Elephants live in herds, not generally numerous, though several herds often congregate together in the same forest or at the same place of drinking. Each herd has a leader, generally the largest and most powerful animal. The leader seems to exercise much control over the movements of the herd, gives the alarm in case of danger, and seems to examine and decide for the whole herd as to the safety



1, Head of Asiatic Elephant; 2, Head of African Elephant.

of proceeding in any particular direction. On account of his tusks, the leader is often the animal against which the efforts of the hunter are directed; but the rest of the herd do their utmost to protect him, and when driven to extremity, they place him in the centre, and crowd so eagerly to the front of him that some of them must often be shot ere he can be reached. A family resemblance is usually readily visible among the elephants of the same herd; some herds are distinguished by greater stature, and others by more bulky form and stronger limbs; some by particularly large tusks, some by slight peculiarities of the trunk, etc. In the E. Indies, distinctions of this kind have long been carefully noticed, and particular names are given to elephants according to them, some being considered as *high-caste*, and others as *low-caste* elephants. An E. which by any cause has been separated from its herd, seems never to be admitted into another, and these solitary elephants are particularly troublesome, in their depredations exhibiting an audacity which the herds never exhibit; they are also

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savage and much dreaded, while from a herd of elephants danger is scarcely apprehended. The E. is generally one of the most inoffensive of animals, though in a state of domestication, it shows, as is well known, a power both of remembering and resenting an injury.

The favorite haunts of wild elephants are in the depths of forests—particularly in mountainous regions—where they browse on branches, and whence they issue chiefly in the cool of the night to pasture in the more open grounds. They are ready to plunder rice or other grain-fields, if not deterred by fences, of which, fortunately, they have, in general, an unaccountable dread. A fence scarcely more than imaginary, of mere reeds, will keep them out of fields, where, as soon as the grain is removed, they enter by the gaps of the fence, and may be seen gleaning among the stubble.

When the E. eats grass, ‘nothing can be more graceful than the ease with which, before conveying it to his mouth, he beats the earth from its roots by striking it on his fore-leg.’ A cocoa-nut is first rolled under foot, to detach the outer bark, then stripped of the fibrous husk, and finally crushed between the grinders, when the fresh milk is swallowed with evident relish. The fruit of the palmyra palm is another favorite food of elephants, and they seem to have an instinctive knowledge of the time of its ripening. Sugar-canies also are favorite food; indeed, elephants are very fond of sweet things. Those which are brought to Europe or America are generally fed on hay and carrots. The weight of daily food necessary for the E. in a state of domestication may be stated, on an average, at about 200 lbs.

Elephants delight in abundance of water, and enter it very freely, often remaining in it for a considerable time and with great evident enjoyment. They sometimes swim with not only the body but the head under water, the only part elevated above it being the extremity of the trunk.

The habits of African E. appear in no important respect to differ from those of the Indian elephant. It is the latter only that is at the present day domesticated; but it is certain that the African species was anciently domesticated, and the figures on many Roman medals attest it.

Elephants rarely breed in domestication, though, a few years ago, the birth of an elephant took place in the Zoological Gardens of London. They are generally tamed within a few months after capture; some degree of severity being employed at first, which, however, as soon as the animal has begun to respect the power of man, is exchanged for gentleness of treatment. Elephants intended for domestication are captured in various ways. It was formerly common to take them in pitfalls, but in this way they were often much injured. Another method frequently practised is by the aid of tame elephants. Male elephants chiefly are captured in this way, the decoy elephants employed being females, trained for the purpose. With these the hunters very cautiously approach the animal they mean to capture, and he generally permits them to come up to him,

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and is so pleased to make the acquaintance of the females, that he takes no notice of their riders and other human attendants. Two of the females take their places, one on each side of him, and while he is occupied with them, men, the profession of whose lives it is, and who have wonderful expertness in the work, contrive to get beneath their bodies, and to pass ropes round the legs of the intended captive. His two hind-legs are fastened together by six or eight ropes in the form of the figure 8, another rope keeping them tight at the intersections, and a strong cable with a running-noose is attached to each hind-leg. About 20 minutes usually are spent in fixing the necessary ropes, profound silence being maintained if the process goes on unobserved, or some of the other hunters distracting the attention of the E. from those who are engaged in this work; and when at last, becoming sensible of his danger, he tries to retreat, an opportunity is soon found of tying him, by means of the long cables which trail behind him, to some tree strong enough for the purpose. His fury then becomes ungovernable, and he makes violent and prodigious efforts to get free, throwing himself on the ground, and twisting himself into the most extraordinary positions. It is not until he has thoroughly exhausted himself, and begins to suffer severely from fatigue, thirst, and hunger, that the next steps are taken toward taming him and making him a willing servant of man.

Still more wonderful is the capture of a wild E., sometimes by not more than two hunters, who for this purpose will go into the woods, without aid or attendants, their only weapon a flexible rope of hide. With this they secure one of the E.'s hind legs, following his footsteps when in motion, or stealing close up to him when at rest, or sometimes spreading the noose on the ground, partially concealed by roots and leaves, beneath a tree on which one of the party is stationed, whose business it is to lift it suddenly by means of a cord. When arrested by the rope being coiled around a tree, the E. naturally turns upon the man who is engaged in making it fast, but his companion interferes on his behalf, by provoking the animal; and thus not only is the first rope made fast, but noose after noose is passed over the legs, until all are at last tied to trees, and the capture is complete; upon which the hunters build a booth for themselves in front of their prisoner, kindle their fires for cooking, and remain day and night till the E. is sufficiently tamed to be led away.

But these huge animals are not always captured singly; whole herds are often taken at once. This is accomplished by means of an inclosure; toward which the elephants are driven by great numbers of men encircling a considerable space and contracting the circle by slow degrees. Weeks, or even months, are spent in this operation, and at last the elephants, hemmed in on every side except the mouth of the inclosure, enter it, and the gate is immediately closed. The modes of constructing the inclosure differ in different countries. Tame elephants are sometimes sent into it, and the captives are in succession made

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fast to trees there, in a way somewhat similar to that practised in capturing single elephants.

The E. became known in Europe first from its employment in the wars of the East: 'In India, from the remotest antiquity, it formed one of the most picturesque, if not of the most effective, features in the armies of the native princes.' Elephants have been taught to cut and thrust with a kind of scimiter carried in the trunk, and it was formerly usual for them to be sent into battle, covered with armor, and bearing towers on their backs which, contained warriors. But the principal use of the E. in war is for carrying baggage, and for dragging guns. An E. will apply his forehead to a cannon, and urge it through a bog, through which it would be almost impossible for men and cattle to drag it; or he will wind his trunk round it, and lift it up, while horses or cattle drag it forward. Elephants are used in the East for carrying persons on their backs, a number being seated together in a *howdah*, while the driver (*mahout*) sits on the E.'s neck, directing it by his voice and by a small goad. Elephants have always a conspicuous place in the great processions and state displays of eastern princes; and white elephants—albinos—are peculiarly valued. Elephants are employed also in many kinds of labor, and show great sagacity in comprehending the nature of their task and adapting themselves to it. In piling timber, the E. 'manifests an intelligence and dexterity which is surprising to a stranger, because the sameness of the operation enables the animal to go on for hours disposing of log after log, almost without a hint or direction from his attendant.'

Of the sagacity of the E., many interesting anecdotes are on record. But Cuvier refuses, apparently with justice, to ascribe to it a degree of sagacity higher than that of the dog. In domestication, the E. is a delicate animal, requiring much watchfulness and care, though naturally it has a very long life, and instances are on record of extreme longevity in domestication, extending not only to more than 100, but almost to 200 years.

The numbers of wild elephants in some parts both of the E. Indies and of Africa, are being gradually reduced as cultivation extends, and many are shot for no other reason than a desire to reduce their numbers, and put an end to their ravages on cultivated grounds. A reward of a few shillings per head was claimed for 3,500 destroyed in part of the n. province alone of Ceylon, in less than three years prior to 1848. It is for the sake of ivory that the greatest slaughter of elephants takes place. A ball of hard metal, skilfully planted in the eye, base of the trunk, or behind the ear, generally ends an E.'s life in an instant; and expert sportsmen have been known to kill right and left one with each barrel.

Fossil Elephants.—The E. makes its appearance in the Pleistocene strata. Its near ally, the mastodon, whose remains are found associated with it, began life earlier; it has left its traces in Miocene deposits. Ten species of fossil elephants have been described, the remains of three

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of which are found in Europe. The best known of these is the *Elephas primigenius*, or mammoth, the tusks of which are so little altered as to supply an ivory which, though inferior to that of the living species, is still used in the arts, especially in Russia. Its tusks are regularly searched for by 'ivory hunters' in Siberia, where, in the superficial deposits of sand, gravel, and loam, the remains occur in enormous abundance. They are found also in similar strata all over Europe. In Britain, the localities that have supplied these remains are very numerous, and are especially abundant in the Pleistocene deposits of the e. and s.e. of England. Woodward, in his *Geology of Norfolk*, calculates that upward of 2,000 grinders of this animal had been dredged up by the fishermen off Happisburgh in 13 years. The bone-caves also yield remains of this gigantic animal.

The mammoth truly belongs to the geological history of the world; it died out at the close of the period represented



Skeleton of Mammoth.

by the beds of the Quaternary (q.v.), or Pleistocene of Lyell. The Mammoth of N. Amer. has been separated as *E. Americanus*, but teeth intermediate between it, as described, and *E. primigenius* were found in Grinnell, Io.; probably these are one species. It was as large, with similarly curved tusks, as the Siberian specimen, which was found preserved in ice so that its flesh was eaten by dogs, bears, and wolves. In 1799, a Tungusian, named Schumachoff, searching the shores of Lake Oncoul for mammoth tusks, observed among the blocks of ice a shapeless mass, but did not at the time discover what it was. The heat of succeeding summers gradually melted the ice around it, and in 1803 the mammoth fell on a bank of sand. In March of the following year, the hunter visited it, cut off, and carried away the tusks, which he sold for fifty rubles. In 1806, Mr. Adams visited the locality, and examined the animal, which still remained on the sand-bank where it had fallen, but greatly mutilated. The Jakutski of the neighborhood had cut off the flesh to feed their dogs,

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and the wild beasts had almost entirely cleared the bones. The skeleton was, however, entire, except one of the fore-legs, and some of the bones of the tail. Many of the bones were still held together by the ligaments and by parts of the skin. The head was covered with dry skin; one of the ears was well preserved; it was furnished with a tuft of hairs. Three-fourths of the whole skin were procured, which was so heavy that ten persons found great difficulty in transporting it 150 feet to the shore; it was of dark-gray color, and was covered with a reddish wool, and long black hairs or bristles. The wool was short, and curled in locks; the bristles were of different lengths, varying from 1 to 18 inches. Some of this covering still remained attached to the skin, but the great mass was entirely separated from it. Mr. Adams collected 36 pounds, though much of it had been destroyed from the dampness of the place where it had lain so long. The animal was a male, and had a long mane on the neck. The entire carcass was removed to St. Petersburg, where it is now preserved. The tusks were repurchased, and added to the animal. It measures from the forepart of the skull to the end of the mutilated tail 16 ft. 4 inches; the height to the top of the dorsal spine is 9 ft. 4 inches; the length of the tusks along the curve is 9 ft. 6 inches. Portions of the hairy covering were deposited in the British Museum.

Taking the teeth as exhibiting clearly a marked difference in the recent species, the mammoth is easily separated from both by its broader grinders, which have narrower, and more numerous, and close-set plates and ridges. The existence in the n. of Europe and Asia of the E. and other genera, whose representatives are now found only in the warmer regions of the earth, led to the belief, that at the recent period in the world's history when they were its living inhabitants, a tropical temperature existed in the temperate zone, and stretched further n. toward the pole; but the discovery of this perfect animal showed that these huge elephants were adapted by their clothing to endure a cold climate, and by the structure of their teeth were able to employ as food the branches and foliage of the northern pines, birches, willows, etc. There are few generalizations more plausible at first sight than to predicate of an unknown species of a genus what is ascertained regarding the known members of the same genus. It required a striking case, such as that supplied by the discovery of the mammoth, to show clearly the fallacy of deductions almost universally received by scientific men not many years ago, which still occasionally mislead, and which even now are found in some popular hand-books of science.

EL'EPHANT, ORDER OF THE: instituted in Denmark, by King Frederick II. The badge was a collar of elephants towered, supporting the king's arms, and having at the end the picture of the Virgin Mary.

EL'EPHANT, SEA (*Macrorhinus proboscideus*), known also as the ELEPHANT SEAL, the PROBOSCIS SEAL, etc.: largest of the seal family (*Phocidae*), inhabitant of the seas

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of the s. hemisphere, now named *Macrorhinus leoninus* (restoring Linnæus's specific name, but in masculine form); also the Californian Sea Elephant (*M. angustirostris*) of s. Cal. and Mex., now comparatively rare. The two much resemble each other, the n. species averaging 12-14 ft., but attaining 22 ft., the females much smaller and without proboscis; the s. species somewhat larger, and with short hair distributed in patches, giving it a spotted appearance somewhat like watered silk. The swimming-paws are large and powerful; the fore-paws have five nails, the thumb-nail easily distinguishable from the others; the hind paws have not even the rudiments of nails, but are beautifully constructed like the webbed foot of a bird, so as to expand, and increase



Sea-Elephant (*Macrorhinus proboscideus*).

the power of swimming. The true tail is very short, not more than six inches long. The head is larger in proportion than in many seals; the eyes are very large and prominent, with eyebrows of coarse hair; the whiskers are composed of very long and coarse spirally twisted hairs; there are no external ears; the canine teeth are remarkably large and massive, somewhat assuming the character of tusks. The nose of the males is very remarkable, being prolonged into a kind of proboscis about a foot long, which, however, is not at all an organ of prehension, and, indeed, seems to serve no purpose whatever analogous to those served by the proboscis of the elephant, but in its ordinary state hangs flaccid on the face, becoming distended like the wattle of a turkey when the animal is roused to passion of any kind, and in particular presenting this distended appearance during the rutting season. At that season, also, the males have furious combats, the victor winning for himself a whole herd of females. When the proboscis is dilated, the voice of the sea-elephant, usually like the lowing of an ox, is completely changed, and becomes a loud and extraordinary gurgling.

Sea-elephants are found on Kerguelen's Land, Juan Fer-

ELEPHANTA--ELEPHANT BAY.

nandez, South Georgia, the States Islands, South Shetland, the Falkland Islands, etc. They migrate southward at the beginning of summer, and northward at the approach of winter, thus avoiding the extremes of heat and cold. A single individual sometimes yields 1,400 or 1,500 pounds or 70 gallons of excellent oil, on account of which these animals are pursued to an extent that seems to have already much reduced the numbers of the species. They are either shot, or killed by means of long lances. Cuttle-fish and other cephalopods seem their principal food; but remains of marine plants also have been found in the stomach.

The skin of the sea-elephant is valueless for fur, but its thickness and strength make it very useful for harness-making and similar purposes. The flesh is black, oily,



1, Skull and Teeth of Sea-Elephant; 2, Swimming-paw, or Flipper

and indigestible; the tongue (salted) alone being esteemed a delicacy. The principal product, however, is the oil, which burns slowly, with a clear flame, and without smoke or disagreeable odor.

ELEPHANTA, *ĕl-ĕ-făñ'ta*: island, 6 m. in circuit, in the harbor of Bombay (q.v.), about 7 m. e. of that city, about 5 m. w. of the mainland. It takes this its European name from a huge figure of an elephant near its principal landing-place, which, however, appears to have gradually crumbled away. This colossal animal has been cut out of a detached rock, apparently of basaltic origin. Further toward the interior, three temples, dug out of the mountain, present themselves—the roofs supported by curiously wrought pillars of various forms and magnitudes, and the walls thickly sculptured into all the varieties of Hindu mythology. The largest of the three excavations is nearly square, 133 ft. by 130½ ft.; and immediately fronting its main entrance stands a bust or third-length of a three-headed deity, with a height of 18 ft., and a breadth of 23. These monuments of superstition, like the quadruped which guards, as it were, the approaches to them, are said to be rapidly decaying—which seems inconsistent with any high antiquity.

EL'EPHANT BAY: inlet of the Atlantic, on the coast of Benguela, s.w. Africa, lat. 13° 14' s., and long. 12° 33' e. It has excellent anchorage, but no fresh water.

ELEPHANTIDÆ—ELEPHANT'S FOOT.

ELEPHANTIDÆ, n. *ĕl-ĕ-făñ'tĭ-dĕ*: in zool. and paleon., family of mammals, typical of the order *Proboscidea*. In addition to elephants it contains the extinct genus *Mastodon*, distinguished from the former by the shape of the crown of its teeth.

ELEPHANTINÉ, *ĕl-ĕ-făñ'tē-nă*: small island of the Nile, opposite to Assouan (q.v.), anc. Syene; on the confines of Egypt and Nubia; 24° 5' n. lat., and 32° 34' e. long. From this island, the Greek mercenaries were sent by Psammitichus I. to recall the Egyptian deserters, and it was garrisoned in the time of the Pharaohs, Persians, and Romans. The island was anciently called *Abu*, or the 'ivory island,' having been the entrepôt of the trade in that precious material. The most important ruins are a gateway of the time of Alexander, and a small temple dedicated to *Khnum*, the god of the waters, and his contemplar deities, *Anucis* and *Sate*. This temple was founded by Amenophis III., and embellished by Rameses III. Another remarkable edifice is the ancient Nilometer, formerly mentioned by Strabo, and which appears to have been built in the time of the Cæsars; and several remaining inscriptions record the heights of inundation from the time of Augustus to Severus. This island had the honor of giving a dynasty (the 5th) to Egypt, and was evidently an important place, the inscriptions on the rocks attesting the adoration paid by Sethos I., Psammitichus II., and other monarchs, to the local deities. Other interesting monuments have been found on this island; among which are part of a calendar recording the rise of the Dog-star in the reign of Thothmes III. (B.C. 1445), and numerous fragments of pottery—principally receipts in the Greek language—given by the farmers of taxes in the reign of the Antonines. The island is at present inhabited by Nubians.—Wilkinson, *Topography of Thebes*, p. 460; Champollion, *Notice Déscriptive*, p. 215; Champollion, *Lettres Ecrites*, pp. 111, 157, 171, 382.

ELEPHANT ISLAND: in Senegambia, in the Gambia River, abt. 100 m. from its mouth.

EL'EPHANT POINT: promontory of Pegu, Further India, marking the w. extremity of the mouth of the Rangoon, the most easterly arm of the Irrawaddy; lat. 16° 28' n., and long. 96° 25' east.

ELEPHANT RIVER: in the Cape Colony of s. Africa. It enters the Atlantic after a course of 140 m., about lat. 31½° s., and long. 18° east.

EL'EPHANT'S FOOT, or HOTTENTOT'S BREAD (*Testudinaria elephantipes*): plant of the nat. ord. *Dioscoreaceæ*, of which the root-stock forms a large fleshy mass, curiously truncate, or abruptly cut off at the end, so as somewhat to resemble an elephant's foot, and covered with a soft, corky, rough, and cracked bark. From this springs a climbing stem, which bears the leaves and flowers. The root-stock is used as food by the Hottentots.

The name ELEPHANT'S FOOT (*Elephantopus*) from the form of the root-leaves, is given also to a genus of plants of the nat. ord. *Compositæ*, sub-order *Corymbiferae*, one spe-

ELETTARIA—ELEUSINIAN.

cies of which (*E. scaber*) is common in elevated dry situations in all parts of India, and is used in Indian medicine in affections of the urinary organs.

ELETTA'RIA: see CARDAMOM.

ELETZ: see JELETZ.

ELEUSINE, ēl-ū-sī'nē: genus of grasses, known as Crab-grass, Yard-grass. *E. Indica*, naturalized chiefly in the s. states, is called Dog's-tail or Wire-grass. Another E. Indian species, *E. corocana*, is cultivated and known as Natchnee. Nagla, Mand, or Murwa; it has digitate spikes finally incurved. The Tibetans make a weak beer, much in use among them, from this grain. *E. stricta* is cultivated as a grain-crop in the same parts of the world, and is, like the former, extremely productive. The grain called Tocusso in Abyssinia is a species of this genus, *E. Tocusso*.—A decoction of *E. Aegyptiaca* is used in Egypt for cleansing ulcers; and a drink made from the seeds is regarded as useful in diseases of the kidneys and bladder. A decoction of *E. Indica* is administered also to infants in Demerara, to prevent or cure convulsions.

ELEUSINIAN, a. ēl-ū-sīn'i-ān: relating to the anc. mysteries of Greece; pertaining to the rites in honor of Demeter or Ceres at *Eleusis*, in Greece. ELEUSINIAN MYSTERIES, sacred rites with which the annual festival of Ceres was celebrated at Eleusis (q.v.). Many traditions were afloat in ancient times as to the origin of this festival. Of these, the most generally accepted was to the effect that Ceres, wandering over the earth in quest of her daughter Proserpine, arrived at Eleusis, where she took rest on the *sorrowful stone* beside the well Callichorus. In return for some small acts of kindness, and to commemorate her visit, she taught Triptolemus the use of grain on the Rharian plain near the city, and instituted the mystic rites peculiarly known as hers. The outward method of the celebration of these mysteries is known with considerable accuracy of detail. Their esoteric significance is very variously interpreted. The ancients themselves generally believed that the doctrines revealed to the initiated gave them better hopes than other men enjoyed, both as to the present life and as to a future existence. Modern speculation has run wild in the attempt satisfactorily to explain these mysteries. As reasonable a solution as any other seems to be that of Bp. Thirlwall, who finds in them ‘the remains of a worship which preceded the rise of the Hellenic mythology and its attendant rites, grounded on a view of nature, less faneful, more earnest, and better fitted to awaken both philosophical thought and religious feeling.’ The festival itself consisted of two parts, the greater and the lesser mysteries. The less important feast, serving as a sort of preparation for the greater, was held at Agræ, on the Ilissus. The celebration of the great mysteries began at Eleusis on the 15th day of Boëdromion, third month of the Attic year, and lasted over nine days. On the first day (called *agurmos*, the assembling), the neophytes, already initiated at the preparatory festival, met, and were instructed in their sacred du-

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ties. On the second day (called Haladé, *mystæ, To the sea, ye initiated!*), they purified themselves by washing in the sea. On the third day, sacrifices, comprising, among other things, the mullet-fish, and cakes made of barley from the Rharian plain, were offered with special rites. The fourth day was devoted to the procession of the sacred basket of Ceres (the Kalathion). This basket, containing pomegranates, salt, poppy-seeds, etc., and followed by bands of women carrying smaller baskets similarly filled, was drawn in a consecrated cart through the streets, amid shouts of 'Hail, Ceres!' from the onlookers. The fifth day was known as the 'day of the torches,' and was thought to symbolize the wanderings of Ceres in quest of her daughter. On it the mystæ, led by the 'daduchus,' the *torch-bearer*, walked two by two to the temple of the goddess, and seem to have spent the night there. The sixth day, called Jacchus, in honor of the son of Ceres was the great day of the feast. On that day the statue of Jacchus was borne in pomp along the sacred way from the Ceramieus at Athens to Eleusis, where the votaries spent the night, and were initiated in the last mysteries. Till this stage of the proceedings, they had been only *mystæ*; but on the night of the sixth day they were admitted into the innermost sanctuary of the temple, and from being allowed to behold the sacred things, became entitled to be called 'epoptæ,' or 'ephori;' i.e., *spectators* or *contemplators*. They were once more purified, and repeated their original oath of secrecy with an imposing and awful ceremonial, somewhat resembling, it is conjectured, the forms of some existing secret societies. On the seventh day, the votaries returned to Athens with mirth and music, halting for awhile on the bridge over the Cephisus, and exercising their wit and satire against the spectators. The eighth day was called Epidauria, and was believed to have been added to the original number of the days for the convenience of those who had been unable to attend the grand ceremonial of the sixth day. It was named in honor of Æsculapius, who arrived on one occasion from his native city of Epidaurus too late for the solemn rites, and the Athenians, unwilling to disappoint so distinguished a benefactor of mankind, added a supplementary day. On the ninth day took place the ceremony of the 'Pleomochoæ,' in which two earthen vessels filled with wine were turned one toward the east, the other toward the west: the attendant priests, uttering some mystic words, then upset both vessels, and the wine so spilt was offered as a libation.

Initiation into the Eleusinia mysteries was compulsory on every freeborn Athenian; but slaves, prostitutes, and persons who had forfeited their citizenship were excluded from the rites. During the period of the festival, none of those taking part could be seized or arrested for any offense. Lycurgus, with a view to destroying distinctions of class, forbade any woman to ride to the Eleusinia in a chariot, under a penalty of 6,000 drachmæ. The mysteries were celebrated with the most scrupulous secrecy. No initiated person might reveal what he had seen under pain of death, and no uninitiated person could take part in the ceremonies.

ELEUSIS—ELEVATE.

under the same penalty. The priests were chosen from the sacred family of the Eumolpidæ, whose ancestor, Eumolpus, had been the special favorite of Ceres. The chief priest was called the 'Hierophant,' or 'Mystagogue;' next in rank to him was the Daduchus, or Torch-bearer; after whom came the 'Hiero-Ceryx,' or Sacred Herald, and the priest at the altar. Besides these leading ministers, there was a multitude of inferior priests and servants.

ELEUSIS, *ē-lū'sis*: celebrated town in ancient Attica, near the n. shore of the Gulf of Salamis, not far from the confines of Megaris. It was famous as the chief seat of the worship of Ceres, whos mystic rites were here performed with great pomp and solemnity from the earliest authentic times till the era of Alaric: see ELEUSINIAN MYSTERIES. The temple of the goddess, designed by Ictinus, architect of the Parthenon, was the largest sacred edifice in Greece. The site of the old E. is now occupied by the little village of Lefsina or Lepsina.

ELEUTHERA, *ē-lū'thēr ā*: one of the Bahamas (q.v.); next to New Providence, most populous island in the whole chain. It is more fertile than most of its neighbors, surpassing all of them especially in the growth of fruit, such as the pine-apple, the orange, and the lemon. Pop., with its dependent cayos or keys, 7,010.

ELEUTHERIA, *ēl-ū-thērī-a*: Greek festival instituted after the battle of Platæa, b.c. 479, in memory of their triumphant repulse of the invasion of Xerxes.

ELEUTHERIA BARK, *ēl-ū-thērī-a bārk*: name frequently given to the bark of the *Croton Eleutheria*, known also as Cascarilla Bark: see CASCARILLA. It is called Eleutheria (or Eleuthera) Bark, because gathered chiefly on the island of Eleuthera.

ELEUTHEROPETALOUS, a. *ēl-ūth'ērō pēt'āl-ūs* [Gr. *eleu'theros*, free; *petalon*, an unfolded leaf]: in bot., poly-petalous. **ELEUTHEROSEP'ALOUS**, a. *-sēp'āl-ūs* [a simple arbitrary conversion of *petalon* into *sepalon*]: polysepalous.

ELEUTHERURUS, n. *ē-lū-thér-ūr'ūs*, [Gr. *eleutheros*, free; *oura*, tail]: in zool., genus of *Pteropidæ*, frugivorous bats. *Eleutherurus agyptiacus* is sculptured on the Egyptian monuments.

ELEVATE, v. *ēl'ē-vāt* [L. *elēvātus*, lifted up, raised—from *e*, out of; *lēvō*, I raise; *levis*, light: F. *élever*: It. *elevare*]: to raise from a low place to a higher; to raise to a higher state or station; to exalt; to refine; to raise in mind and habits; to raise in height, as the voice. **EL'EVATING**, imp. **EL'EVATED**, pp. raised; exalted; dignified; excited; in *her.*, applied to wings turned upward. **EL'EVATOR**, n. *-tēr*, one who, or that which, raises or exalts; a machine for raising weights or loads; in *anat.*, a muscle which serves to raise a part of the body; in *surg.*, an instrument for raising the depressed portion of a bone; also **EL'EVA'TORY**, n. *-tērī*, an instrument for raising a depressed or a fractured part of the skull: **Adj.** able or tending to raise. **EL'EVA'TION**, n. *-vā'shūn* [F.—L.]: the act of raising from a lower to a

ELEVEN—ELF-ARROW-HEADS.

higher state or condition; exaltation of character or style; raised ground; in *arch.*, sketch-plan of the flat side (usually front or principal) of a building, drawn with mathematical accuracy, but without the slightest regard to effect. ELEVATION, in *art*, a raising of the subject beyond its ordinary character in real life. A good instance (see Fairholt in his *Dictionary of Terms in Art*) is Rembrandt's *Adoration of the Shepherds*. The whole of the objects and surroundings of the infant Savior are of the most homely description; yet the light represented as issuing from his person gives an elevation to the scene which takes from it entirely the character of being commonplace or vulgar. ELEVATION, in *astron.* and *geog.*, generally the height above the horizon of an object on the sphere, measured by the arc of a vertical circle through it and the zenith. Thus, the elevation of the equator is the arc of a meridian intercepted between the equator and the horizon of the place. The elevation of the pole is the complement of that of the equator, and is always equal to the latitude of the place. The elevation of a star, or any other point, is similarly its height above the horizon, and is a maximum when the star is on the meridian. The angle of elevation, is the angle through which a heavenly object appears elevated above the horizontal plane, to a spectator looking upward. ELEVATION OF THE HOST [see HOST 3]: in *R. Cath. Chh.*, the lifting up of the sacred elements of the Eucharist after consecration, that they may be seen of all the people. ÉLÈVE, n. *ā-lēv'* [F. élève, a pupil; élevé, bred, educated]: one reared or protected by another; a pupil; a disciple.—SYN. of 'elevate': to raise; lift; heave; hoist; erect; heighten; elate; cheer; flush; excite; animate; enoble; dignify.

ELEVEN, n. *ē-lēv'n* [AS. *endleofan*; Goth. *ainlif*, eleven, literally one placed upon ten: Lith. *likti*, to remain over: comp. first syllables of Gr. *leipein*, to leave; L. *lictus*, left]: ten and one added. ELEV'ENTH, a. *-lēv'nth*, next after the tenth; in *music*, interval of the octave above the fourth. ELEV'ENTHLY, ad. *-lī*, in the eleventh place. Note.—Skeat rather suggests Goth. *ainlif*—from *ain*, one; *lif* = Lith. *lika* = L. *decem*, ten, by the change of *l* to *d*.

ELF, n. *ēlf*, ELVES, n. plu. *ēlvz* [AS. *aelf*; Icel. *alfr*; Ger. *alp*, supernatural beings of the Northern mythology]: a fairy; a wandering spirit; an undersized or mischievous demon (see FAIRIES). ELFIN, a. *ēlf'īn*, of or relating to elves: N. playfully applied to a child, as being small and mischievous. ELFISH, a. resembling an elf; in secret disguise. ELVAN, a. *ēlv'ān*, same as ELFISH. ELF, v. *ēlf* [Gael. *ailbheag*, a ring, a curl]: in *OE.*, to twist and entangle the hair in rings and knots. ELF-LOCK, in *OE.*, matted or intricately entangled hair. ELVISH, a. *ēlv'ish*, in *OE.*, from ELFISH. ELF-FIRE, the Will-o'-the-wisp.

ELF-ARROW-HEADS, or ELFIN-ARROWS, or ELF-BOLTS, or ELF-DARTS, or ELF-SHOT, or ELF-STONES: names popularly given in the British Islands to the artificial arrow-heads of flint in use at an early period among the barbarous tribes of Europe generally, as still among the American

ELF-ARROW-HEADS.

Indians, the Esquimaux of the Arctic regions, and the inhabitants of some of the islands in the Pacific Ocean. These are often included under the general term Celt (q.v.). It was believed that elves or fairies, hovering in the air, shot these barbs of flint at cattle, and occasionally even at men. Thus, Robert Gordon of Straloch, an accomplished country gentleman of the n. of Scotland, writing 1654, tells how one of his friends, travelling on horseback, found an elf-arrow-head in the top of his boot, and how a gentlewoman of his acquaintance, when out riding, discovered one in the breast of her habit. He remarks that, though they are got by chance in the fields and on the highways, one who goes to look for them on purpose will seareh in vain. He adds that they are most commonly met with after showers—which may have helped them in Germany to their names of ‘thunder-bolts,’ and ‘thunder-stones,’ and is easily explained. The rain, by washing away the earth in which they have been embedded, makes them more readily perceptible to the eye, especially if the sunshine happens to fall upon them. Cattle dying suddenly in the fields were believed to have been struck by elf-arrows—a belief which yet lingers in Ireland, and perhaps in some secluded parts of Scotland. ‘Thus, when cattle are siek,’ writes Mr. W. R. Wilde, in his *Catalogue of the Antiquities in the Museum of the Royal Irish Academy* (Dub. 1857), ‘and the cattle doctor, or fairy doctor, is sent for, he says the beast has been “elf-shot,” or stricken by fairy or elfin darts; and he forthwith proceeds to feel the animal all over; and, by some legerdemain, contrives to find in its skin one or more poisonous weapons, whieh, with some coins, are then placed in the water which is given it to drink; and so a cure is said to be effected.’ The elf-arrow-head was occasionally set in silver, so as to be worn on the person as a talisman, or had a hole drilled through it, so that it might be dipped in water, which, being thus endowed with healing virtue, was used sometimes as a wash, more commonly as a draught. As a talisman, the elf-arrow-head was believed most efficacious as a preservative from poison and witchcraft. The ascription of the flint arrow-head to the elves or fairies, is but one of several instances of the disposition of a people to elevate or degrade the earlier races whom they vanquished or dispossessed into mythical beings, better or worse than mankind. Thus, in Greece and Italy, the remains of the rude strongholds built by the Pelasgi came to be regarded as works of the fabled Cyclops, or one-eyed giants. So in Scotland, the sepulchral mounds of the aboriginal inhabitants were called ‘elf-hillocks;’ and the vestiges of ancient plowshares which may be traced on heaths and hill-tops were called ‘elfin-furrows.’ Examples of ‘elf-arrow-heads’ may be seen in most museums of antiquities. See CELT: FLINT IMPLEMENTS AND WEAPONS.



Elf-Arrow-Head.

EL-GHOR—ELGIN AND KINCARDINE.

EL-GHOR ('the long valley'): modern name of the valley of the Jordan and the Dead Sea from Mount Hermon to the Akrabbim or chalk cliffs six m. s. of the Dead Sea. Its length between the Sea of Galilee and the Dead Sea, is about 65 Eng. miles. At its n. end it is about six m. wide, and at Jericho twelve. Its w. wall is a series of precipitous and desolate cliffs, 800 to 1,200 ft. high. On its e. side the hills are still higher. Between the two seas an abrupt ridge (Kurn Surtabeh) divides the Ghor into two parts; the n., over 40 m. long, is well watered, and might be made very productive; the s., about 20 m. long, is covered with a white nitrous crust which makes it hopelessly desolate. The difference of level between the seas (according to Lieut. Lynch's measurement) is 660 ft., giving a descent of 10 ft. to a mile. Within this valley is a second depression (also extending n. to s.) 40 to 150 ft. lower. Through it the Jordan flows with a very winding course which makes it 200 m. long. The descent being steep and broken, the navigation of the river is always perilous and, under ordinary circumstances, impossible. Lynch and his party, having many advantages and safeguards, accomplished the passage (1848) through the whole distance; having plunged down many dangerous rapids, and barely escaping with their lives.

ELGIN, *ĕl'jĭn*: city of Kane co., Ill.; on both sides of the Fox river; at junction of the Chicago and Northwestern, and the Chicago and Pacific railroads; 20 m. n. of Aurora, 36 m. w.n.w. of Chicago, 50 m. e.s.e. of Rockland. Excellent water power is supplied by the river, here spanned by a handsome iron bridge. There are 3 national banks (cap. \$450,000), and 1 state bank; a city hall; 16 public schools including a high-school and 2 grammar schools; an academy; 13 churches; the Northern Insane Asylum, which cost \$500,000; and 14 periodicals. E. is noted for extensive and varied manufactures, and contains the national watch works (established 1866, cap. \$1,500,000), employing 1,000 skilled hands, male and female, and turning out 50,000 watches valued at over \$800,000 annually; also the Borden milk-condensing works, milk and cheese factories, boiler, engine works, woolen mill, manufactories of mowers, reapers, agricultural implements, wringers, barbed wire, carriages, school furniture. Pop. (1870) 5,441; (1880) 8,787; (1890) 17,823; (1900) 22,433.

ELGIN, *ĕl'gĭn*: royal burgh, county town of Elgin or Morayshire, Scotland. It is beautifully situated on the river Lossie, five m. from the sea. Contains 10 churches and Grays Hospital and Insane Asylum. Pop. (1891) 6,633.

EL'GIN AND KINCAR'DINE (JAMES BRUCE), eighth Earl of: 1811, July 20—1863, Nov. 10: Gov. Gen. of India: b. in Park Lane, London; son of Thomas Bruce, seventh Earl, who secured Elgin Marbles (q.v.). He went to Christ Church, Oxford; became Fellow of Merton, and graduated M.A. 1835. He entered public life 1841, was elected to parliament for Southampton—but the election was declared void—and, through the death of his father, succeeded

ELGIN AND KINCARDINE.

ing to a Scotch peerage, he was, in his own words, ‘expelled from the house of commons without being admitted into the house of peers.’ He was made gov. of Jamaica 1842; and in 1846 became gov.gen. of Canada, under the administration of Lord J. Russell. His administration in Canada was a model of colonial government. During his rule, 1847–55, the revenue of Canada was quadrupled. He negotiated a treaty for reciprocity of trade between British America and the United States, which admitted the whole produce of British N. America into competition with the products of the United States in their own markets. This treaty, till it was renounced by the United States 1866, removed the risk of collision as to the fisheries, whieh Lord E. described as the most serious risk which had presented itself during his public service. He was summoned to the house of lords 1849, as a peer of the United Kingdom, and was appointed lord-lieut. of Fifeshire. Under appointment as Plenipotentiary Extraordinary he started, 1857, for China with an army, to settle various difficulties. But before he reached his destination the Indian mutiny broke out, and Lord E. unhesitatingly dispatched the Chinese expedition to Lord Canning’s assistance; and the English in India were thus enabled to hold their ground until re enforcements arrived. Afterward, 1858, he negotiated with China the favorable treaty of Tien-tsin; also a treaty with Japan. On his return home, he was appointed postmaster-general; but soon was sent again to China,—the Chinese having fired on the British squadron from the Taku forts; and in conjunction with a French expedition, penetrated to the capital, and dictated peace under the walls of Pekin. On the expiration of Viscount Canning’s term of service, the gov.-generalship of India was offered by Lord Palmerston to Lord E. (1861), and accepted by him. He died in India. Lord E. was twice married: in 1841, to the daughter of Mr. Cumming Bruce, M.P. (she died 1843); and in 1846, to the daughter of the first Earl of Durham, by whom he had a son, Victor Alexander, present earl, born 1849, and other issue. Lord E. was K.T. (1847), privy councillor (1857), G.C.B., civil, extra (1858).

ELGIN MARBLES.

ELGIN MARBLES: celebrated collection of ancient sculptures, brought from Greece by Thomas, seventh Earl of Elgin, and acquired from him by the nation for the British Museum 1816, at the sum of £35,000.

These sculptures adorned certain buildings on the Acropolis of Athens; the chief portions, from the Parthenon or



Theseus.

Temple of Minerva, were designed by Phidias, and executed by him, or under his superintendence. They consist of—1. Portions of several of the statues that were in the east and west tympana or pediments, the most important of which are the Theseus or Hercules, Ilissus or river-god, upper

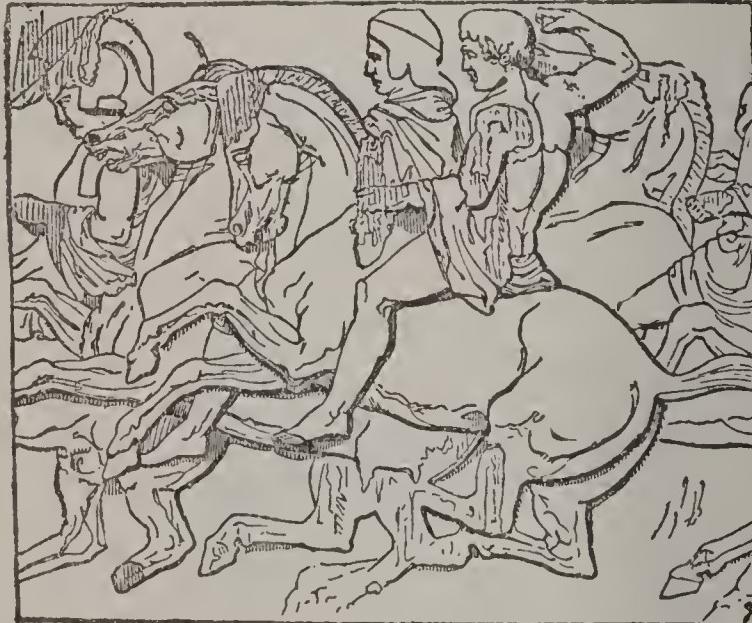


Metope:
From the Parthenon.

portions of the torsos of Neptune and Minerva, Iris, torso of Cecrops, Ceres, and Proserpine, the Fates, heads of the horses of Hyperion, and one of the horses of Night. Of all

ELGIN MARBLES.

these, the Theseus, and the head of the horse of Night, are the most perfect, the former wanting only the hands and feet and part of the nose, while even the surface of the latter is very little injured. But however mutilated, the greatness in style of these magnificent works is clearly manifest, and from the merest fragment valuable instruction in art may be obtained. 2. Fifteen metopes, executed in high relief, representing the battle of the Centaurs and Lapithæ. A metope is the interval between the triglyphs on a Doric frieze—in the Parthenon, there were 92, 14 on each front, and 32 on each flank of the temple—and on every metope, a Centaur engaged in conflict with one of the Lapithæ is represented in a style of the highest excellence in point of spirit and truthfulness. 3. A large portion of the frieze of the outer walls of the cella. This remarkable work represents the solemn procession to the Temple of Minerva during the Panathenaic festival, and has never been equalled for elegance of composition and the variety and gracefulness of the figures. It is executed in low relief, in order to adapt it to the light, for placed within the colonnade, it received its light between the columns, and by reflection, from the pavement below. This exquisite frieze occupied, slab after slab, a space of 524 ft. in length. The remains



Portion of Panathenaic Frieze.

of it in the British Museum on slabs and fragments of marble are to the extent of upward of 249 ft., besides 76 ft. in plaster casts.

Although the Elgin Marbles are now acknowledged the most precious collection existing of specimens of Greek art in its purest state, yet it was only after considerable hesitation that government consented to purchase them, and then the sum awarded was not only far short of their value, but also far short of Lord Elgin's expense in procuring them. Again, from petty jealousy, some of the connoisseurs of the day underrated these great works;

ELGINSHIRE.

while others, like Lord Byron, from feelings apparently generous, but quite mistaken, heaped obloquy on Lord Elgin, and opposed their acquisition. But it has been clearly proved that Lord Elgin, so far from destroying, saved these master-pieces from destruction. M. Viardot, author of *Les Musées d'Europe*, remarks: ‘It is said that, to justify the appropriation of the Lahore diamond, the English allege that if they have taken it, it was merely to prevent its appropriation by others. They may give the same excuse for their appropriation of the marbles of the Parthenon. No doubt, Lord Elgin has carried them off; and the Greeks of the present day, seeing the old temple of their Aerropolis despoiled of all of its ornaments, have a good right to curse the despoiler. But when we think of the devastation these works have so often experienced, to the total destruction of the principal statues, and the shameful mutilation of the others, and the risk these last ran of being entirely destroyed in their turn—when we consider that these precious relics of art are conserved in a place of surety, and placed in the centre of artistic Europe, one loses the desire, and almost the right to charge the English with piracy and robbery. For my part, if, in the course of my long devotion to the marbles of Phidias, a regret has come to trouble the ardent pleasure of my admiration, it was, that the robber of these marbles was not a Frenchman, and their resting-place the Museum of Paris.’—*Visconti on the Sculptures in the Collection of the Earl of Elgin* (John Murray, London, 1816), *Library of Entertaining Knowledge—British Museum* (London, Charles Knight).

ELGINSHIRE, *el'gɪn-shér*, or MORAYSHIRE, or MURRAYSHIRE, *mür'ɪ-shér*: maritime county in the n.e of Scotland, on the Moray Firth; 30 m. long, 20 m. broad; 482 square m. About a third part was formerly cut off on the s. by a detached part of Inverness-shire; but by an act of parliament, passed in 1870, this part was annexed to Inverness-shire, and a part of the intervening portion of Inverness-shire, of about the same extent, rental, and population, was annexed to Elginshire. In the s. are the high and rugged Monadhliadh Mountains of Inverness-shire, dividing the basins of the Spey and Findhorn, and forking in the n. to include the basin of the Lossie. In the s., gneiss predominates, with a little granite; and in the n., sandstone with fish and reptilian remains, and small patches of oolitic and Wealden strata. West of the Findhorn mouth are the sand-dunes of Culbin, three sq. m. in extent, some of them rising 118 ft. Great masses of peat and trunks of trees are often cast ashore near the mouth of the Findhorn. The climate is mild and dry, and the county has been called the Devonshire of Scotland, the mountains of Aberdeenshire and Banffshire protecting it from the cold moist winds of the German Ocean. The soil is open, sandy, and gravelly, and very fertile in the n., with some deep loams and clays. In 1881 nearly a third of the county—105,226 acres—was under crop, the chief crops being oats, barley, and turnips. The chief exports are grain,

ELIA—ELIE DE BEAUMONT.

cattle, salmon, and timber. There are some manufactures of woolens and malt liquors. E. unites with Nairnshire in sending one member to parliament. It contains 14 entire parishes, and 8 parts of parishes. In 1871, 84·87 per cent of children, from 5 to 13 years of age, were receiving education. The total valuation of E., including the burghs of Elgin and Forres, was (1879-80), £227,852: this includes railways. The ancient province of Moray included the counties of Elgin and Nairn, and parts of those of Inverness and Banff. Scandinavians early settled in it. About 1160, Malcolm IV. subdued it. The chief antiquities are Elgin Cathedral, Spynie Castle, Duffus Castle, Pluscarden Abbey, Kinloss Abbey, and the Norman parish church of Birnie. Burghead, on the coast, is supposed by many to have been a Roman station, but its ramparts and ditches, now almost destroyed, were probably of more recent origin. It was the last stronghold of the Norsemen in this part of Scotland. E. was overrun in the civil was of Montrose, 1645, etc.—Pop. (1881) 43,788; (1891) 43,448.

ELIA: see LAMB, CHARLES.

ELIAS, *ē-lī'as*, MOUNT ST.: mountain on the n.w. coast of America, lat. 60° 18' n., long. 140° 30' w. 18,023 ft. high; long supposed to be the highest peak in N. America, but found by the international boundary survey of 1894 to be overtopped by Mt. Logan on Canadian soil, 19,500 ft., and Mt. Wrangle in Alaska, still higher but not yet accurately surveyed. It is near the point where the shore, after trending n.w., turns due w. It lies partly in Alaska and partly in Canada; its summit is in dispute between the two countries, but is probably in Canada.

ELIASITE, n. *ē-lī'as-īt* [named from the *Elias* mine, Joachimsthal, where it occurs]: subtranslucent or opaque mineral occurring in shapeless masses. There are two varieties: E. proper, reddish-brown; and pittinite, black; both closely akin to gunnrite, an alteration-product of uraninite.

ELICIT, v. *ē-līs'it* [L. *elictus*, drawn out, lured forth—from *e*, out of; *lacīō*, I allure: It. *elicere*]: to draw out; to extract; to deduce by reason or argument. ELIC'ITING, imp. ELIC'ITED, pp. ELIC'ITA'TION, n. -ī-tā'shūn, the act of eliciting or drawing out.

ELIDE, v. *ē-līd'* [L. *elidērē*, to strike out—from *e*, out of; *lādo*, I strike forcibly, I hurt: F. *élider*]: to cut off or suppress a vowel or syllable, usually a final one. ELI'DING, imp. ELI'DED, pp. ELI'SION, n. -īz̄h'ūn [F.—L.]: the cutting off or suppression of a vowel or syllable at the end of a word, as in poetry, in order to make the lines of the requisite length.

ÉLIE DE BEAUMONT, *ā-lē'dēh bō-mōng'*, JEAN BAPTISTE ARMAND LOUIS LÉONCE: 1798, Sep. 25—1874, Sep. 21; b. Canon, France: geologist. He was educated in the Polytechnic School; made a series of metallurgical explorations for the govt. 1821-24, and was appointed a mining engineer on his return; became prof. at the school of mines 1829, prof. of geology in the College of France 1832; chief engineer of

'ELI, ELI, LAMA SABACHTHANI—ELIJAH.

mines 1833; member of the Institute 1835; and perpetual sec. of the Acad. of Sciences, succeeding Arago, 1853. In his *Treatise on the Mountain Systems* (1852), he described 95 distinct systems.

ELI, ELI, LAMA SABACHTHANI? *ē'li ē'li lā'mā sā'būk-thā'nī* [Syro-Chaldaic tongue; called also Hebrew-Syriac]: ‘My God, my God, why hast Thou forsaken me?’—the exclamation of Jesus Christ on the cross in His extreme agony; also ELOI, ELOI, etc., *ē'lō-i ē'lō-i*.

ELIGIBLE, a. *ē'lī-jī-bl* [F. *éligible*—from mid. L. *eligībilis*—from L. *elīgō*, I choose or pick out—from *e*, out of; *tego*, I choose]: fit to be chosen; suitable; proper; legally qualified; desirable. EL'IGIBLY, ad. *-jī-blī*. EL'IGIBLNESS, n. *-bl-nēs*, or EL'IGIBIL'ITY, n. *-bīl'ī-tī*, worthiness or fitness to be chosen; that which renders one thing preferable to another.

ELIJAH, *ē-lī'jah* (Gr., in the New Testament, ELIAS): greatest of the prophets of Israel; born at Tishbe, in Gilead, on the borders of the desert. He comes upon the scene in the time of Ahab, about B.C. 920. When that monarch, to please his Phoenician wife Jezebel, had introduced, on an extensive scale, the polluted worship of Baal, E. pronounced a curse on the *land*. The prophet had to flee. He took refuge by the brook Cherith, probably one of the torrents that cleave the high table-land of his native region. Here he was miraculously fed by ravens. He then went to Zarephath, a town between Tyre and Sidon. Here he lodged with a widow woman, prolonged her scant supply of oil and meal, and brought back her son to health from the brink of the grave. Subsequently, he made a temporary reconciliation with Ahab, and on Mount Carmel executed dreadful vengeance on the prophets of Baal, slaying 400 with his own hand. Such a deed enraged Queen Jezebel to the utmost. She swore to destroy the prophet, who once more took refuge in flight. He rested not till he reached Beersheba in the far south, on the edge of the desert that leads down to Sinai. The brief allusion in Scripture to his weary wandering is very touching. At last he comes to Horeb, where he is brought into personal converse with Jehovah. The passage in which this is recorded is one of the grandest and most significant in the Old Testament. He then receives certain instructions from Jehovah, among others that he should select Elisha to be prophet in his room. E.’s next appearance is when Ahab rides forth to take possession of Naboth’s vineyard: he denounces the murderous monarch, and utters an awful prophetic curse on him and his wife. After the death of Ahab, he with fearful solemnity and sternness rebukes the idolatries of his son Ahaziah; and after the death of King Ahaziah, we find E. interfering in the affairs of the king of Judah, who had married a daughter of Ahab, and begun to ‘walk in the ways of the kings of Israel.’ He denounced his evil doings, and predicted his death. The closing scene of his life on earth and of his translation without death, is exquisitely narrated. A.

ELIMINATE—ELIOT.

chariot of fire and horses of fire appeared after he with Elisha had crossed the Jordan, and ‘Elijah went up by a whirlwind into heaven.’ E. is one of the grandest and loftiest figures on human records—in times of abounding evil, a stern, solitary, uncompromising reprobate of kings, and reformer of the nation, a mighty prophetic monitor from Jehovah.

ELIMINATE, v. *ě-lím'i-nát* [L. *eliminatus*, turned out of doors—from *e*, out of; *līmen*, a threshold; It. *eliminare*; F. *éliminer*]: to set at liberty; to get rid of anything; to throw out or reject something from an argument; in *alg.* to cause a quantity to disappear from an equation; to disengage; to separate. **ELIMINATING**, imp. **ELIMINATED**, pp. **ELIMINATION**, n. *-nā'shūn* [F.—L.]: the act of expelling or discharging. In *alg.*, a process by which, where we have a number of statements concerning several quantities, we can obtain a separate statement concerning each. Thus, an operation which consists in riddance of a quantity or letter which is common, say, to two equations, by forming out of the two a new equation, in such a way as to make the quantity in question disappear. If three unknown quantities, for instance, are to be found from three independent equations, the first step is to form out of the three given equations two new equations, so as to eliminate one of the unknown quantities; from these two equations another of the quantities is eliminated in the same way, giving one equation with one unknown quantity, the value of which is then found. In complicated equations, elimination becomes difficult, and often impossible. Elimination is an important process in other sorts of reasoning besides the mathematical; in this larger acceptation, it means the setting aside of all extraneous considerations—of everything not essential to the result. In astronomical observations, the elimination of errors of observation is often effected by repeating the observations several times in such a way as to cause the errors to be of opposite kinds, then adding the observed values, and taking their average.—The word to ‘eliminate,’ is often erroneously used in the sense of to ‘elicit,’ or bring to light: it has no such meaning.

ELIOT, *ěl'i-ot*, CHARLES WILLIAM, LL.D.: b. Boston, 1834, Mar. 20: educator. He studied in the Boston Latin School; graduated at Harvard Univ. 1853; was tutor in mathematics there 1854–58; asst. prof. of mathematics and chemistry 1858–61; prof. of chemistry in the Lawrence Scientific School 1861–63; travelled and studied in Europe 1863–65; prof. of chemistry in the Mass. Institute of Technology 1865–69; and was elected pres. of Harvard Univ., succeeding Dr. Thomas Hill, 1869, May 19. As pres. he has had the elective system introduced, and has brought the institution closer to the forms of the great European universities. Beside numerous addresses, chemical memoirs, and technical investigations, he has published in conjunction with Prof. F. H. Storer, a *Manual of Inorganic Chemistry* (N. Y. 1869), and a *Manual of Qualitative Chemical Analysis* (1869). He received the degree LL.D. from

ELIOT.

Williams and Princeton Colleges 1869, and Yale Univ., 1870.

ELIOT, GEORGE: see EVANS, MARIAN.

ELIOT, JOHN: 'the apostle to the Indians': 1604-90; b. Nasing, England. He graduated at Cambridge 1622, and was ordained in the Church of England, but under persecution as a non-conformist came to Boston, Mass., 1631. He became pastor of the church (Congl.) in Roxbury 1632. Soon afterward, having, with the aid of a captive Pequot, gained some knowledge of the language of the Indians (whom he regarded as portions of the lost tribes of Israel), he began to preach to them at Nonantum (now Brighton), four m. from Roxbury. He translated for them the ten commandments, the Lord's prayer, and many texts of Scripture. In 1647, he first preached to them without an interpreter. He was bold in his work, and when opposed and threatened by the chiefs replied, 'I am doing the work of the great God, and He is with me; touch me if you dare.' As the fruit of his labor a settlement of Christian Indians was formed. This (1651) was removed 8 m. away to Natick, where an Indian church was organized 1660. In aid of these labors, an English missionary soc. sent him £50 annually to supplement his salary of £60 at Roxbury. In 1653, he published an Indian catechism, and in 1665, a tract containing a statement of the belief and experience of his converts. Having been strenuously employed many years (with aid from the Rev. John Cotton of Plymouth, Mass.) in translating the Scriptures, he published the New Testament 1661, and the Old, 1663. A second edition of the New Testament was published 1680, and of the Old, five years later. His *Indian Grammar Begun*, printed 1666 (reprinted 1822), has these words at the close: 'Prayers and pains, through faith in Jesus Christ, will do anything.' Of his *Indian Primer* (1669) a copy has been preserved in the library of the Univ. of Edinburgh. From this it was reprinted 1877. Copies of his Indian Bible are now very rare, and few persons, if any, can read it. But his labors are still useful to those who study the structure and character of unwritten dialects. E. published also many treatises in the English language. Among these were: *Indian Dialogues* (of which a copy is preserved in a private library in New York); *The Logick Primer* (one copy in the British Museum, another in the Bodleian Library); *The Christian Commonwealth, or The Civil Policy of the Rising Kingdom of Jesus Christ*. This was published in London, and, because it favored a republican form of government, was charged with teaching sedition. Parts of it were condemned by the governor and council of Massachusetts. Almost to the last E.'s diligence in writing was maintained. 'He was charitable to the poor even to excess. Nearly all his salary from England he gave to the Indians; and on one occasion the parish treasurer of Roxbury tied up the money paid him in a handkerchief with hard knots to prevent his giving it away before he reached home. But E. went at once to a family who were sick and poor,

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and, telling them that God had sent them relief, tried to untie the knots. Finding the task difficult, he gave them handkerchief and all, saying 'Take it; God seems to intend that you shall have the whole.' He was greatly beloved for his pure life and gentle manners in village homes and Indian huts. He died in Roxbury, where he had lived and labored nearly 60 years. All New England lamented his death as a public calamity.

ELIOT, Sir JOHN: 1592, Apr.—1632, Nov. 27; b. Port Eliot, England: statesman. He entered Exeter College, Oxford, when 15 years old, and on completing his univ. course travelled extensively in France, Italy, and Spain, with the future Duke of Buckingham, and began studying law in one of the inns of court. In 1612 he married the daughter of a wealthy neighbor, 1614 was elected a member of parliament, and 1619 was appointed vice-admiral of Devon and intrusted with large powers for the defense of the commerce of the county. He entered upon his naval duties with remarkable energy, and directed his first efforts to the capture of Nutt, a famous pirate, who had inflicted immense damage upon the commerce of the s. coast of England for several years, and who was known to have powerful friends at court. After many attempts he caught the pirate, 1623, but his adroitness proved of no immediate avail, as Nutt was speedily released to continue his plundering, while E. was arrested on groundless charges and confined in the Marshalsea four months. In 1624, Feb., he was elected to parliament for Newport. Believing that the success of the popular cause required the entire independence of parliament, he proposed at an early day that the deliberations of the house of commons should be kept strictly secret. His boldness attracted a large share of official and popular attention; and this element combined with his intense energy, personal bravery, resoluteness, and high oratorical gifts, made him the foremost leader in the commons during the first three parliaments of the reign of Charles I., though such patriots as Pym, Hampden, Selden, and Coke were members at the time. He courageously exposed the abuses which oppressed England through illegal exactions and the venality of the executive; urged parliament to demand an account of the expenditure of the supplies that it had voted, and to refuse further supplies till an accounting was made; repeatedly charged the Duke of Buckingham, the king's favorite, with the responsibility for the general misgovernment; and was sent to the Tower 1626 for comparing the duke with Sejanus. The commons espoused his cause, refused to transact any business till he was released, and upon his reappearance voted him free from fault. Later in the year he was confined in the Gatehouse, whence he personally petitioned the king against further forced loans, was deprived of his office of vice-admiral, and had a sentence of outlawry passed upon him. In 1628 he was elected to parliament for Cornwall, and vehemently urged the commons to vote no further supplies till they obtained redress of their grievances. He was one of the framers of the 'petition of right,' and when an evasive response was given to it, reviewed the events of the

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whole reign, and proposed a remonstrance to the king, naming Buckingham as the cause of the country's wretchedness. On the last day of that parliament, while Holles and Valentine held the speaker of the house in the chair by force, he protested against levying tonnage, poundage, and other duties without the consent of parliament. Upon the dissolution of parliament he was again sent to the Tower for refusing to answer for his conduct in parliament anywhere except before parliament. He was closely confined till May, then taken before the court of king's bench where he again refused to answer, was condemned to pay a fine of \$10,000 and be imprisoned during the king's pleasure; was placed in solitary confinement 1631, Dec., and died while awaiting an answer to a petition to the king for a temporary release on account of his health.

ELIQUATION, n. *ēl'i-kwā'shūn* [L. *eliquātus*, melted out—from *e*, out; *liquo*, I melt]: the separation of substances that melt at different temperatures by raising the heat sufficient to melt the one but not the other.

ELIS, *ē'līs*: one of the ancient divisions of the Peloponnesus, bounded n. and n.e. by Achaia, e. and s. by Arcadia, w. by the Ionian Sea. It was originally divided into three districts—Cœle or Hollow Elis, Pisatis, and Triphylia. Of these, the first-named was by far the largest and most valuable, comprising the broad and fertile plains watered by the Peneus and the Ladon, and producing excellent crops of grain, cotton, and flax; while the pastures by the river-banks reared cattle and horses of proverbial excellence. This district, from its fertility, was called ‘the milk-cow of the Morea.’ Pisatis is drained by the Alpheus, and is separated from Cœle Elis by Mount Pholoë, a spur of Erymanthus. The low grounds of this division have great natural fertility. Most of the surface of Triphylia is hilly, occupied with offshoots from the great Arcadian ranges. It is separated from Pisatis by the Alpheus, on whose banks were the grove and temple of Olympic Jove, and the plain in which the great Olympic games were celebrated. Though E. had few facilities for preventing invasion, it yet suffered less from war than any other of the Greek states—an advantage due chiefly to the sacred character of the country, as the seat of the greatest of the national festivals. Their prerogative of holding the Olympic games gave the Eleans a prestige which continued in greater or less degree till the games themselves were suppressed by Emperor Theodosius A.D. 394.

ELIS, now *Kaloscopi*, cap. of the country of E., stood on the Peneus, and was long famous as one of the most splendid and populous cities of Greece. It was at one time strongly fortified, and contained many magnificent buildings, conspicuous among which was the Gymnasium, in which it was necessary that all athletes intending to take part in the Olympic games should go through a month's training before they were allowed to compete. See Leake's *Morea*, and Curtius's *Peloponnesus*.

ELISHA, *ē-lī'sha*: died abt. B.C. 840. Prophet of Israel,

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successor of Elijah, who found him at the plough, and called and consecrated him to the sacred office by throwing his mantle over his shoulders. He exercised his functions for 55 years. When Elijah was carried up into heaven, E. returned to Jericho, where he dwelt for some time. He then went to Bethel, where occurred the destruction of the 42 children by the two she-bears. After this period, he seems, besides performing an extraordinary number of miracles, to have been active in the religious politics of his country, but he showed nothing of the fiery and sanguinary zeal of his master. Mild, tolerant, conciliatory, he is scarcely ever, if at all, found rebuking the Baal-worship still prevalent in Israel. Many wonderful incidents have place in his history; such as those of the invisible horses and chariots of fire round about E. on the hillside, of the smiting of the Syrian host with blindness, so that the prophet led them all unconsciously into Samaria, captive, etc. With Elijah, it has been said (see Smith's *Dictionary of the Bible*, Art. 'Elisha'), the miracles are introduced as means toward great ends, and are kept in complete subordination thereto. But with E., as he is pictured in the Hebrew narrative the case is reversed; with him, the miracles are everything the prophet's other work is of small moment. The man who was for years the intimate companion of Elijah, on whom Elijah's mantle descended, appears chiefly as a worker of prodigies, a predictor of future events, a revealer of secrets, and things happening out of sight or at a distance. Some commentators have hence felt some difficulty in the literal acceptance of the narrative of E.'s miracles, which difficulties have been dealt with by various methods, more or less satisfactory. For several years E. was the chief theocratical counselor of King Jehoram. Under the reign of Jehu and his successors, he gradually withdrew from public affairs, and died in Samaria in the reign of Jehoash, grandson of Jehu. A parallel has been drawn between E. and Christ, occasioned by his mildness and gentleness; but this must be deemed quite superficial, and without warrant in the Biblical records. E. is canonized in the Greek Church; his day is June 14.

ELISION: see under ELIDE.

ÉLITE, n. *ā-lēt'* [F. *élite*—from L. *elīgērē*, to choose out]: the flower of an army; a select circle or chosen part; the chosen representatives of society, art, science, literature, or the like.

ELIXIR, n. *ě-lǐks'ér* [Ar. *el iksir*, the philosopher's stone, the life-prolonging tincture of gold; F. and Sp. *elixir*]: a refined spirit; a cordial which invigorates; the quintessence of any substance. The term as now used in pharmacy, has come down from the days of alchemy when it denoted a supposed magical liquor for conferring immortality, which concoction was earnestly sought after by the old alchemists. It is applied to various preparations, consisting mostly of solutions of aromatic and bitter vegetable substances in spirits of wine. The term tincture is now more common. **ELIXIR OF VITRIOL**, or Aromatic

ELIZABETGRAD.

Sulphuric Acid, is prepared from $1\frac{1}{2}$ fluid ounces of sulphuric acid (oil of vitriol), 10 fluid ounces of rectified spirit, $\frac{1}{2}$ oz. cinnamon in powder, 1 oz. ginger in powder. The acid is gradually added to the spirit, and the mixture being placed in a closed vessel, is allowed to digest at a gentle heat for three days; the cinnamon and ginger are then added, and after being allowed to stand about six days, the whole is strained through cloth. The elixir of vitriol has been deemed useful for quenching thirst, sharpening the appetite, checking profuse perspiration, and often reducing the action of the pulse. The dose may range from 10 to 40 minims, and is administered in a wine-glassful of water, or some mild liquid, as infusion or conserve of roses.—ELIXIR VITÆ OF MATHIOLUS is composed of alcohol, and upward of twenty aromatic and stimulating substances, and was formerly administered to patients suffering from epilepsy.

ELIZABETGRAD, *ä-lé-zá-bět-grád'* or *yá-*: town of s. Russia, in a plain about 130 m. n. of Kherson. It is well built, with streets straight, wide, and adorned with avenues of trees. E. has a large arsenal within the walls, and is protected by bastions. There is brisk trade, and an annual fair. E. is a great military centre. In 1881 there were murderous assaults on the Jews who are numerous here. Pop. (1875) 35,179; (1889) 57,884; (1897) 61,841.

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ELIZABETH: city, cap. of Union co., N. J.; on Staten Island Sound and the E. river; 2 m. w. of Newark Bay, 5 m. s.s.w. of Newark, 14 m. w.s.w. of New York. It is on the line of the Penn., N. J. Central, Lehigh Valley, New York and Long Branch, New York and Philadelphia, and the Amboy branch of the Penn. railroads; and is connected with important commercial points by lines of steamboats and sailing vessels that navigate the great channel of Staten Island Sound. It covers a wide expanse of level land, is laid out with broad and handsome streets, running at right angles, has numerous business blocks that compare favorably with those of much larger cities, is sewer'd, lighted with gas and electricity, and noted for the large number of handsome residences of N. Y. business men. In 1900 there were 419 manufacturing establishments with a capital of \$15,665,-545, employing 10,497 hands, paying in wages \$6,024,497, yielding products valued at \$20,546,468. Chief articles manufactured were sewing-machines, oil cloth, hats, saws, mill-machinery, stoves, hardware, edge tools, harness, cordage, and combs. A large business is done in the shipment of anthracite coal. E. is divided into 8 wards; has 2 national banks (cap. \$550,000), 2 state banks (cap. \$100,000), a savings-bank, 3 daily and 3 weekly periodicals, an admirable public school system; and, beside 8 missions, 30 churches, divided denominationally as follows: Presb., 7; Rom. Cath., Bap., and Meth. Episc., each 5; Prot. Episc., 4, and Congl., German Lutheran, German Moravian, and Jews, each 1. Among the buildings of note are the co. court house, city hall, opera house, 2 high schools, an orphan asylum costing \$60,000, 2 public halls, and 4 academies and institutes. In 1873-82 Elizabeth experienced serious financial troubles and was driven into insolvency. Before the panic of that time speculators and wooden pavement companies formed themselves into rings, bought property on the outskirts of the city, made themselves freeholders, and demanded of the council the opening of steets which that body had no right to refuse. Millions of dollars were borrowed and other millions laid upon the vacant land in the shape of assessments, that could not be paid when the panic came. On 1879, Feb. 1, when the city suspended payment of interest, the debt amounted to \$5,638,000, and the assessed valuation to \$11,412,118. Negotiations for a settlement of the debt were begun 1880. In 1902, Mar. 1, the bonded debt including unadjusted bonds was \$3,267,840; the sinking fund \$3,453; the net debt \$3,264,387. Total assessed valuation for 1902 was \$20,168,000. E. was settled first by a company of whites from L. I., who bought land on E. river from the Indians, 1665. In the summer of the same year Capt. Philip Carteret, bearing a governor's commission from Sir George Carteret to the whole region between the Hudson and Delaware rivers known then as *Nova Casarea*, arrived there with a considerable company of English gentry and servants, and named the place Elizabeth Town, in honor of Sir George Carteret's wife. It became immediately the seat of govt. The first Gen. Assembly of N. J. convened there 1668, the first trial by jury oc-

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curred 1671, the settlement was incorporated 1740, the College of New Jersey (afterward removed to Princeton) was established there 1747, and E. remained the cap. of the state till 1790. Pop. (1860) 11,567; (1870) 20,832; (1880) 28,229; (1885) 32,149; (1890) 37,764; (1900) 52,130.

ELIZABETH, *e-liz'a-beth*, Queen of England: 1533, Sep. 7—1603. Mar. 24 (reigned 1558–1603): daughter of Henry VIII. and the unfortunate Anne Boleyn. While she was in her third year, her mother was beheaded. Afterward E. was sent to the country, where, in comparative poverty and seclusion, under the care of ladies who leaned to the ‘new learning,’ and sometimes, though seldom, with the companionship of her brother Edward, or her sister Mary, the greater part of her early youth was spent. When Catharine Parr became queen, E., who was a favorite with her, was more seen at court; but from some unknown cause, she incurred her father’s displeasure, and was again sent to the country. Her father died when she was 13 years old. During the reign of her brother Edward, her life passed quietly and peacefully. She was then remarkable for a great demureness and sobriety of manner, discoursing with her elders with all the gravity of advanced years. Edward used to speak of her as his ‘sweet sister Temperance.’ During her sister’s reign, this demureness was exaggerated into prudery, and the vanity which, in after-years, with ampler means at its command, displayed itself in the utmost profusion of personal decoration, then sought for distinction by excess of plainness. Her Protestantism, and the way in which court was paid to her by the Prot. nobility, caused uneasiness to Mary and her council. On her sister’s command, she conformed to papacy, but the insincerity of the conformity deceived no one. Upon the pretext of having been concerned in Wyatt’s rebellion, she was sent 1554 to the Tower. She entered it with all the gloomy forebodings which the fate of so many royal ladies who had been recently within its walls, could suggest. In daily fear for her life, many months passed. Indeed, the warrant for her execution was at one time prepared; and it is unquestionable that the stern bigotry of Mary and her councilors, Gardiner and Bonner, would have sacrificed E., but for the fear of popular commotion. The people, however, regarded E. with great favor, and many already looked forward to the time when the death of Mary should free the court from foreign influence, and give room for a milder government. Thus the life of E. was saved, but for some time longer she was kept a prisoner at Woodstock. During the remainder of Mary’s reign, E., though occasionally at court, resided chiefly at her residence of Hatfield House, in Hertfordshire, where she occupied herself with feminine amusements, and the study of classical literature, under the learned Roger Ascham.

When Mary died (1558, Nov. 17), E. was 25 years of age. Her accession was welcomed alike by Rom. Catholic and Protestant. The former were, outwardly at least, the majority in Mary’s reign; but among them there were few

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who really cared for the peculiar doctrines of the Roman Church, and there were many who were weary of priestly interference, foreign dictation, and cruel persecution. Like E. herself, there were many who had conformed merely to save themselves from trouble. They had obeyed the Six Articles in Henry's time; had agreed to the Prot. settlement of Edward; had turned with Queen Mary, and were now ready to turn again with Queen Elizabeth. The Protestants, of course, who had never believed the sincerity of E.'s conformity, welcomed her to the throne. E. then began, amid dangers and difficulties, a reign which, contrary to the expectation of all, was of unexampled length and prosperity. It would be wrong not to attribute to her influence some effect in producing the great changes in England during the next 44 years; but so far as these changes were not produced in the natural course of the development of the nation's powers, and so far as they bear the mark of an individual mind, they bear much more the impress of the bold yet cautious judgment and clear intellect of the great minister, Cecil, than of the sovereign's will. It is to the highest praise of E. that her first act on succeeding was to consult with such a man, and that to the very last she could bend her capricious temper to his control.

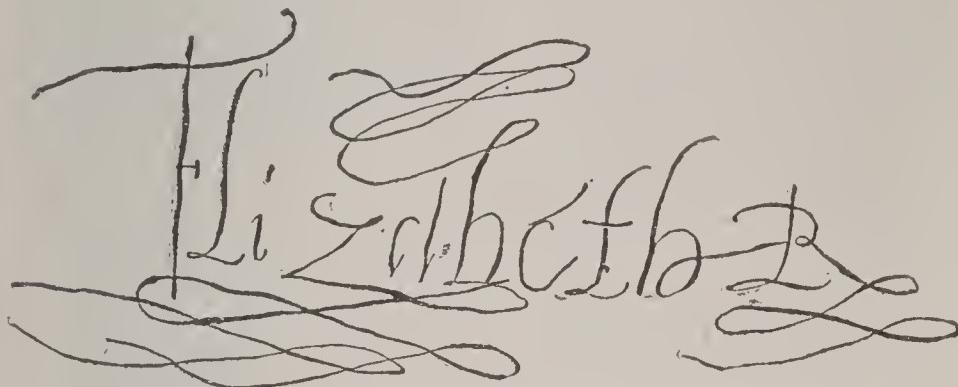
How the government influence was to be directed, was not long in being shown. Till parliament should meet E. issued a proclamation that the English language should be used in the greater part of the church service, and that the Host should not be elevated by the priest during mass. This sufficiently indicated into what hands power had passed, and was enough to throw the mass of the indifferent to the side of the Protestants, and to cause a Prot. majority to be returned to E.'s first parliament. The acts of this parliament must be ever memorable in English history. It was then that England took its position as a Protestant power. The Book of Common Prayer, retaining, doubtless, some mixture of medieval thought, but vivid with new energy, was appointed to be used in all churches; the Thirty-nine Articles were settled as the national faith; the queen was declared to be head of the church. Thus all allegiance to Rome was thrown off. This revolution was soon accomplished, and with little turmoil. The bishops, with one exception, refused to conform; but as a sign of the times, marking how thoroughly the priesthood must have become demoralized before their power was lost, it is noteworthy that of the 9,000 clergymen who held livings in England, there were fewer than 200 who resigned, rather than obey the new order of things.

The policy of E.'s ministers was one of peace and economy. They found the nation at war with France and Scotland, and one of their first acts was to secure peace upon favorable terms. Ever afterward, they followed the same path. No war was undertaken in her reign for the sake of territorial conquest. To strengthen her own throne, E. secretly succored the Protestants in Scotland, in France, and in the Low Countries; but she had few open wars. To be at

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peace with a government, may, apparently to be upon the most amicable of terms with it (as E. was with the French court, while she sent assistance to the Huguenots at Rochelle), and at the same time to aid its rebellious subjects, was in those days thought only part of the politic dissimulation without which, it was believed, no nation could be safely ruled. To maintain the security of her own throne, and to prevent foreign interference in English matters, was the mainspring of E.'s foreign policy; and she lost no opportunity of weakening and finding occupation abroad for any foreign power that unduly threatened her authority.

The one great blunder of England's policy was the treatment of Mary Queen of Scots. Had E. pursued a straightforward course, when her rival was thrown into her hands, much evil might have been spared. Some of the English



Fac-simile of Queen Elizabeth's Signature.

ministers were prepared to take effectual measures to remove a life which might be turned into so dangerous a tool in the hands of Rom. Catholics. E. shrank from that course, but had not the courage and generosity to set Queen Mary at liberty. Had this course been taken, Mary would have gone to France or Spain, would have made a foreign marriage, and as a foreigner would have lost the only sources of her real power—the sympathies of the Scotch and English Rom. Catholics. As it was, E. retained her a prisoner, and thus for years gave cause to conspiracy after conspiracy among the English Rom. Catholics. For a rebellion incited to set Mary free, the richest and most popular of the English nobility, Norfolk, was put to death. The discovery of every new plot led to demands, on the part of parliament, for the death of Mary. The plots then took a graver aspect. The assassination of E., and the placing of Mary on her throne, became the object. On the discovery of Babington's conspiracy for this purpose, the popular cry was irresistible, and was joined in by Cecil and Walsingham, and others of E.'s ministers, who had sinned too deeply against Mary to run the risk of her succession to the throne. With reluctance and hesitation, the sincerity of which need not be questioned, E. consented; and Mary, after long years of confinement, was condemned and beheaded.

This led to new evils. The participation of the Rom. Cath. party in the plots was retaliated by persecution.

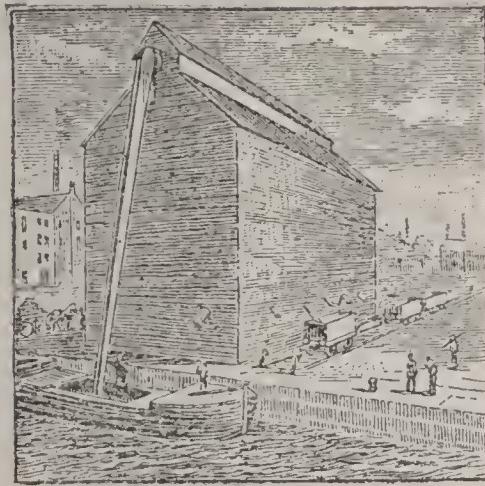
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Many suffered under an act passed 1585, making it treason for a Rom. Cath. priest to be in England, and felony to harbor one. These cruel measures were the ultimate means of bringing upon England the most menacing foreign attack which she had suffered. Philip of Spain had long meditated vengeance against England. The greatest state in Europe, enriched by splendid acquisitions in the new world, could ill brook that a power of the second rank should incite rebellion among her subjects in the Netherlands, should aid the Protestants in their desperate struggle against Alva, and allow its ships (little better than pirates, it must be confessed) to enter the Spanish harbors, and cut out the rich laden galloons. These were the real reasons: to restore the Rom. Cath. faith, and to revenge the death of a Rom. Cath. queen, furnished ostensible reasons. Years had been spent in preparation. In 1588, the 'Invincible Armada' sailed from the Tagus, manned by 8,000 sailors, and carrying 20,000 soldiers. To aid these, a land-army of 100,000 men was to be transported from the Netherlands under the Duke of Parma. The news roused all England, and every man who could carry arms—Prot. and Rom. Cath. from 18 years of age to 60—was enrolled in the forces. The old queen herself rode at Tilbury, energetically encouraging the army. A fleet of 200 vessels and 15,000 seamen gathered itself on the s. coasts, and waited the attack. Superior skill and courage gained the victory for the English; and what these had begun, the force of the elements completed. The splendid Armada was broken and destroyed before it could join the land-army, not a soldier of which ever left foreign ground; while not a seaman of the fleet, save those whom shipwrecks sent, ever set foot on English ground.

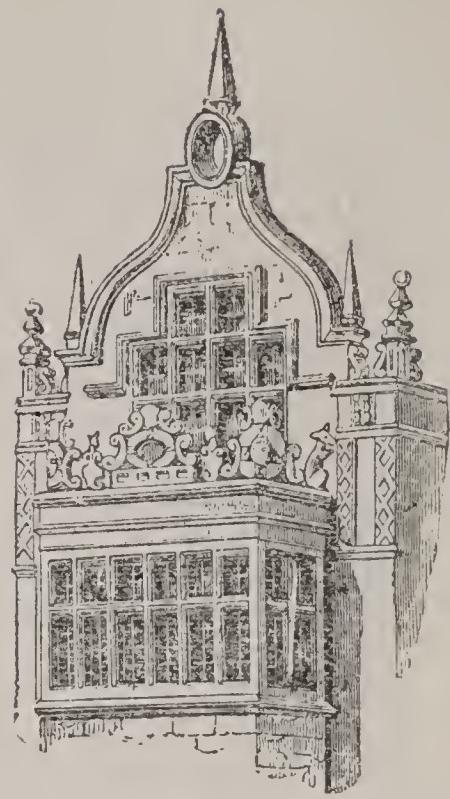
E. died nearly 70 years of age, having reigned nearly 45 years. If the life of her rival, Mary of Scotland, read somewhat like a tragedy, the private life of E. might afford abundant materials for comedy. Always parading her wish to live an unmarried life, E. coquettled with suitor after suitor till long after that period of life when such proposals verge upon the ridiculous. Of her father's schemes to marry her to the Scotch Earl of Arran or to Philip the son of Charles V.—afterward husband of Mary—it is unnecessary to speak, for E. had personally little to say in regard to them. But she was scarcely more than a child when her flirtations with the handsome Lord Admiral Seymour—brother of the Protector Somerset—had passed the bounds of decorum. In Mary's reign, E. was flattered with the attentions of her kinsman, the Earl of Courtenay, and she declined the hand of Philibert of Savoy, pressed on by her sister's council. When queen, with some hesitation she refused the offer of Philip II., who was desirous of perpetuating his influence over England, and she began that connection with Leicester, which so seriously compromised her character. It is certain that she loaded him with honors so soon as she had them to bestow; allowed him to become a suitor for her hand within a few days after the sudden death of his wife, Amy Robsart, attributed by all England to his agency; and allowed him to re-

PLATE 18.

Elevator
Elm



Elevator.



Elizabethan Architecture. —
Window, Rushton Hall (*circa* 1590).



Common English Elm (*Ulmus campestris*). *a*, Flower; *b*, Fruit.

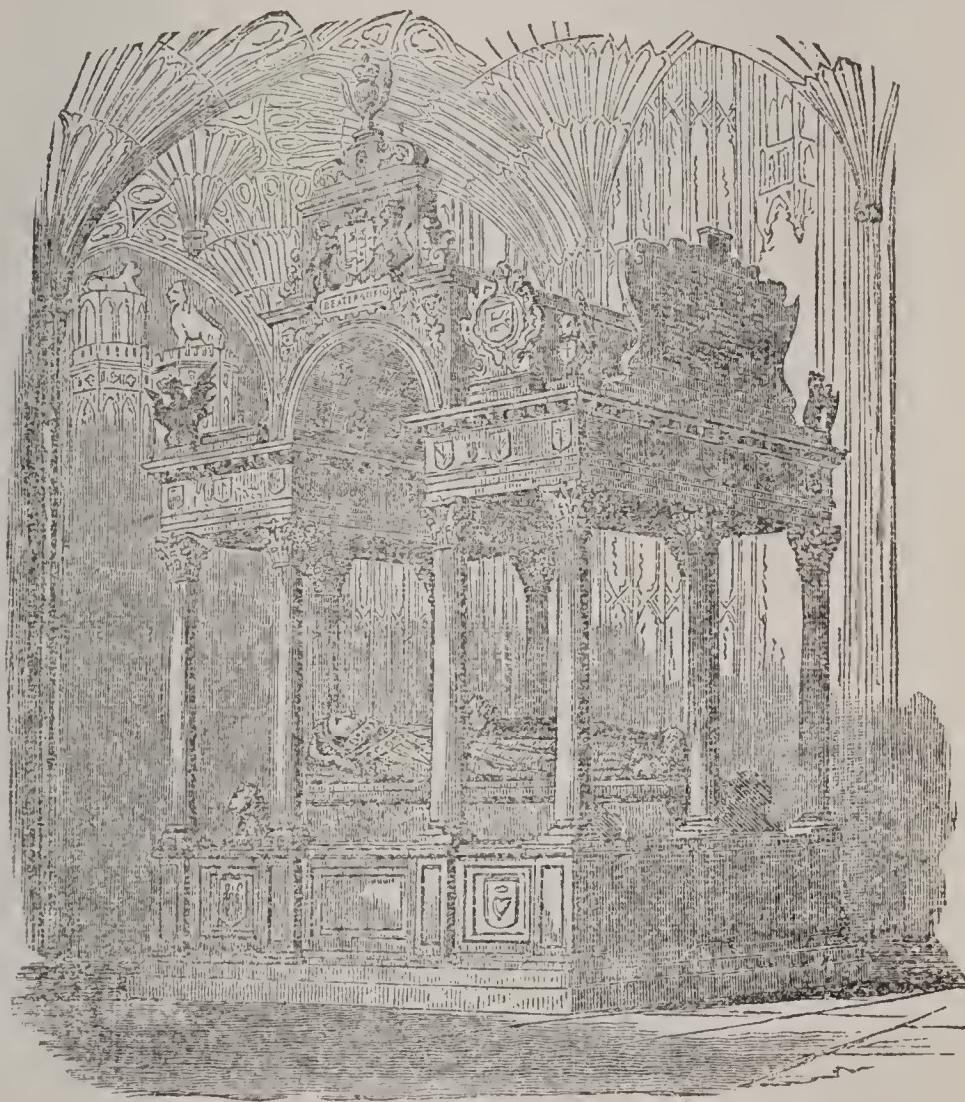
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main a suitor long after his open profligacy had disgusted the nation, and had even opened her own eyes to his worthlessness. If we credit the scandal of the times, the intimacy was of the most discreditable kind. If we credit those sources of information, recently turned to more profit by Mr. Froude than by any of his predecessors, which are found in the dispatches of the bp. of Aquila, ambassador of Philip II. in London, preserved in the archives of Simancas, not only was the moral character of E. sullied with the darkest crimes, but even the quality for which she has ever been most honored, her English patriotism, was mere affectation. These dispatches represent her as accessory—at least, after the fact—to the murder of Amy Robsart, and as offering to Spain to become Rom. Catholic, and to restore the Spanish ascendancy in England, if Philip would support her on the throne as the wife of Leicester; and they represent her as being restrained from giving way to the fatal consequences of her wild passion only by Cecil's control. That there is some basis of truth in this revelation, it is scarcely possible to deny; but the hatred with which Philip regarded E., after her refusal to marry him, has undoubtedly led the courtly bishop to gross exaggerations. It is undeniable, however, that had E. followed her own inclinations, she would have married Leicester. Her ministers, wisely for the nation, prevented this, but E. never seriously entertained another proposal. Cecil could prevent her marrying whom he would not, but he could not bring her to marry whom he would. Among less distinguished suitors, the Archduke Charles of Vienna, and Prince Eric of Sweden pressed their suit in vain. Petitions from parliament to the queen to marry, only excited her maidenly wrath, and produced dignified replies that she would attend to the matter when the time came. Years passed on, and she remained a spinster. Catharine of Medici, queen-mother of France, intrigued to marry her to one of her sons, Henry of Anjou (afterward Henry III.), or the Duke of Alençon, afterward Duke of Anjou. When the foreign envoys pressed the suit of the latter, E. was 38 years of age, and her suitor 19; but they ingeniously flattered her that she and he looked of the same age, for she, by her good preservation, looked nine years younger than she was; while the Duke, by his wisdom, gravity, and mature intellect, looked nine years older. This flattery, with more plausible attractions, was without effect.

E.'s position gave too much scope for the development of the unamiable and ridiculous features of her character. The personal vanity displayed in her extravagant dress, her conversation, her 'high and disposed' dancing, excites a smile, not lessened when we read of the irritable mistress boxing the ears of her councilors, cuffing her attendants, indulging in expressive masculine oaths, and amusing herself with rough masculine sports. The assertion that she was of a cruel disposition is false. That she could do cruel things when her vanity was concerned is sufficiently attested by her ordering the right hand of a barrister, named Stubbes, to be struck off for writing a remonstrance against

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Her marriage with the Duke of Alençon, which she thought unduly reflected on herself; but in her reign, the reckless waste of human life which marked the reigns of her predecessors was unknown. She was not, however, of fine feelings. Her brother could compliment her on the calm mind and elegant sentences with which she replied to the communication of the death of her father. On the news of her sister's death, she burst out with rhapsodical quotations from the Psalms; and when she heard of the execution of the death sentence on her lover Seymour, she turned away the subject with something like a jest. By her attendants, she was more feared than loved. The one quality which never failed her, was personal courage; and when she chose, her demeanor was stately and royal. Religion



Queen Elizabeth's Tomb:

In the North Aisle of Henry VII.'s Chapel, Westminster Abbey.

was with her, as with a great proportion of the nation at that time, a matter more of policy and convenience than of feeling or principle. She preferred Protestantism, from early associations, because it gave her the headship of the church, freed her from foreign interference, and was more acceptable to her ministers and to the nation. But she

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had conformed in Mary's time to Rom. Catholicism with little difficulty; and, had there been necessity for it, she would rather have reigned a Rom. Cath. than not have reigned at all. To the last, she retained in her private chapel much of the ritualism of the Roman Church; and while refusing her Rom. Cath. subjects the exercise of their religion; she entertained the addresses of Rom Catholic suitors. How thoroughly incapable she was of appreciating a matter of religious principle may be gathered from the fact, that she looked upon the deep Puritan movement, destined soon afterward to take so important a part in the nation's development, as some frivolous controversy about the shape of clerical vestments. Of toleration, then well enough understood by Bacon and the more advanced spirits of the age, she had no conception.

What makes the name of E. so famous, was the splendor of her times. In her long reign, the true greatness of England began. Freed from the possession of those French provinces which rather harassed than enriched—with little domestic commotion—with no great foreign wars—with an almost complete immunity from religious persecution, the nation turned to the arts of peace. An unequalled literature arose. The age that produced Spenser, Shakespeare, and Bacon, could not be other than famous. Under Frobisher and Drake, maritime adventure began, and the foundations of British naval force were laid. Commerce, from being a small matter in the hands of a few foreign merchants, developed itself largely. The Exchange of London was opened in E.'s time; and in the charter which she granted to that company of merchant adventurers, which afterward took the name of the East India Company, may be seen one of the small beginnings of a vast colonial empire. The social condition of the people also greatly improved in her reign. The crowds of vagabonds which the monastic institutions had fostered, and who had pillaged the country in all ways on the secularization of the monastic property, died out, or were absorbed in industrious employments. The last traces of bondage disappeared. Simultaneously with the growth of greater comfort and intelligence in the people, parliament began to assert, with greater vigor, its constitutional rights. The right of the commons to free speech, and to initiate all money-bills, was steadily asserted; and the right of the crown to grant monopolies, or to issue proclamations having the force of law, vigorously assailed. In the later years of her reign, the attempts of E. to gain arbitrary power, and her caprices, had forfeited the popularity which she so anxiously cultivated. But after her death, her fame revived; and during the time of the Stuarts, amid the jealousy of the Scotch, the troubles of the civil wars, and the hatred of a Rom. Cath. sovereign, the nation looked back with fond regard to the long reign of the 'Good Queen Bess,' when peace had prevailed, and the government had been thoroughly English.

ELIZ'ABETH, SAINT: 1207-1231, Nov. 19; b. Presburg; daughter of Andreas II., King of Hungary. At the age of

four, she was affianced to the Landgraf of Thuringia, Louis IV., called the Pious, and brought to his court to be educated under the eyes of the parents of her future husband. She early showed what may be called a passion for the severities of the Christian life, as it was conceived in those days. She despised pomp, avarice, ambition; cultivated humility, and exhibited the most self-denying benevolence. Her conduct, even as a girl, astonished the Thuringian court; but such was the grace and sweetness of her disposition, and the excellence of her beauty, that Louis—though her affections seemed to be given wholly to God—still wished to marry her. They were united when E. was only 14. Louis himself, far from blaming the devout girl whom he had made his wife for her long prayers and ceaseless almsgiving, was himself partially attracted to a similar mode of life. A boy and two girls were the fruit of their union; but the happiness of E., so far as it depended on anything earthly, was shattered by the death of her husband 1227, when absent on the crusade headed by Barbarossa. Her confessor, Conrad of Marburg, a narrow fanatical monk (to whose miserable teaching E. mainly owed her perverted idea of life and duty), had trained her to stifle the emotions of her nature as sinful, and the poor widow hardly dared to bewail her loss. Great misfortunes soon befell her. She was deprived of her regency by the brother of her deceased husband, and driven out of her dominions on the plea that she wasted the treasures of the state by her charities. The inhabitants of Marburg, whose miseries she had frequently relieved, refused her an asylum, for fear of the new regent. At last she found refuge in a church, where her first offering of duty was to thank God that he had judged her worthy to suffer. Subsequently, after other severe privations, such as being forced to take up her abode in the stable of a hostelry, she was received into the monastery of Kitzingen by the abbess, who was her aunt. When the warriors who had attended her husband in the crusade returned from the East, she gathered them round her, and recounted her sufferings. Steps were taken to restore to the unfortunate princess her sovereign rights. She declined the regency, however, and would accept only the revenues which accrued to her as land-gravine. The remainder of her days were devoted to incessant devotions, almsgivings, mortifications, etc. There is something mournfully sublime in her unnatural self-sacrifice. We read of this beautiful tender-hearted creature washing the head and feet of the scrofulous and the leprous, and Murillo has a painting (now in the Museum at Madrid) of this act of devotion. The solemn tragedy of her brief life assumed toward its close a ghastly intensity through the conduct of her confessor, Conrad, who, under pretence of spiritual chastisement, used to strike and maltreat her with brutal severity. The alleged cause of this was Conrad's aversion to her 'squandering' her money among the poor. Perhaps he thought it should have gone to *him*. At last her health gave way; and, at the age of 24, E. died, victim partly of ill-usage and partly of a mistaken theory of

ELIZABETHAN—ELIZABETHAN ARCHITECTURE.

religious life, but as gentle and saintly a soul as figures in the history of the middle ages. She was canonized four years after her death. See Montalembert's *Histoire de Sainte Elisabeth de Hongrie* (Paris 1836). The Rev. Charles Kingsley's dramatic poem, entitled *The Saint's Tragedy* (London 1848), is founded on the story of E.'s life.

ELIZABETHAN, a. *ē-liz'ā-bēth'ān*: after the manner or model of the time of Queen *Elizabeth*.

ELIZABETHAN AR'CHITECTURE, *ē-liz'ā-bēth'-an*: mixed style which sprang up on the decline of Gothic architecture. By some it is called the Tudor style, but that name belongs more correctly to the Perpendicular, or latest kind of Gothic. The Elizabethan is exemplified chiefly by



Holland House.

mansions erected for the nobility in the reigns of Elizabeth and James I. It originated in the first attempt to revive classic architecture, influenced, no doubt, by Holbein, who was patronized by Henry VIII., and furnished several designs in this manner. John of Padua succeeded him, and built in the mixed style a palace for the Protector Somerset (for which purpose the cloisters of St. Paul's were taken down), and the mansion of Longleat for his secretary, Sir John Thynne. The vast dimensions of the apartments, the extreme length of the galleries, and enormous square windows, are the leading characteristics of this manner of building. The ornaments both within and without were cumbrous; nothing could exceed the heaviness of the cornices and ceilings wrought into compartments; in short, the architecture was in keeping with the dress of the period, rich and gorgeous, rather than elegant, graceful, and comfortable. The following examples of mansions of the 17th c. are still seen near London: Holland House, Campden House; and the following in Kent: Sir T. Willow's at Charlton, the Marquis of Salisbury's at Hatfield, and Knowle, the prop-

ELIZABETH ISLANDS—ELIZABETH PETROVNA.

erty of the Duke of Dorset. The most eminent architects of those times were John Thorpe, Gerard Christmas, Randolph Symonds, and Thomas Holt.

ELIZABETH ISLANDS: cluster of 16 small islands off the coast of Mass., between Buzzard's Bay and Vineyard Sound, constituting the township of Gosnold in Dukes co. The principal ones are Naushon, Nashawena, Pasque, Cuttyhunk, Nonamessct, Uncatena, and Penikese. Naushon has been occupied as a summer residence for many years; Nashawena, Pasque, and Cuttyhunk are occupied in summer by New York clubs for yachting and fishing purposes; and Penikese was given by John Anderson with all its buildings and an endowment of \$50,000 to Prof. Louis Agassiz for the establishment of a summer school of natural history, 1873; this school has been discontinued. The E. I. were discovered by Bartholomew Gosnold, who founded a colony on Cuttyhunk, 1602.

ELIZABETH PETROVNA, *pă-trov'nă*, Empress of Russia: 1709–1762, Jan. 5 (reigned 1741–1762); daughter of Peter the Great and Catharine I. On the death of Peter II. 1730, she allowed Anna, Duchess of Courland, to ascend the throne, she herself being apparently indifferent to anything but the indulgence of her passions. Anna died 1740, and Ivan, son of her niece (also called Anna), an infant of two months, was declared emperor, and his mother regent during his minority. Shortly after this, a plot was formed to place E. upon the throne; the two principal agents in it were Lestocq, a surgeon, and the Marquis de la Chetardie, the French ambassador. The officers of the army were soon won over; and on the night of 1741, Dec. 5, the regent and her husband were taken into custody, and the child Ivan conveyed to Schlüsselburg. The leading adherents of Anna were condemned to death, but pardoned on the scaffold, and exiled to Siberia. By eight o'clock in the morning, the revolution was completed, and in the afternoon all the troops did homage to the new empress. La Chetardie was handsomely rewarded; and Lestocq was created first physician to the empress, pres. of the College of Medicine, and privy councillor. E., however, did not possess the qualities requisite in a ruler. She lacked energy, knowledge, and love of business, and allowed herself to be guided by favorites. In order to strengthen her position, E. took pains to win over her nephew, the young prince Peter, son of her sister, the Duchess of Holstein-Gottorp. She summoned him to Petersburg 1742, and proclaimed him her successor. E. took part in the Austrian War of Succession, and in spite of the opposition of France, dispatched an army of 37,000 men to the assistance of Maria Theresa, and thereby hastened the conclusion of the peace of Aix-la-Chapelle 1748. E. showed herself less placable toward Frederick II., against whom she cherished a personal enmity, excited by some severe expressions he had made respecting her. At the commencement of the Seven Years' War, she allied herself with Austria and France, and marched her troops into the Prussian states. Her

ELIZABETH STUART.

troops gained the victory in the battles of Grossjägerndorf and Kunersdorf, and took possession of Berlin, but without any decisive result. E. died before the expiration of the war. She founded the Univ. of Moscow and the Acad. of Art at St. Petersburg. Though no person was put to death during her reign, the most shocking punishments were inflicted, and thousands were exiled to Siberia and Kamtchatka. E. had several illegitimate children. Profligacy, espionage, and persecution reigned in her court, the administration of justice was restrained, and the finances neglected; nevertheless she was extremely strict in the observance of the public ordinances of religion.

ELIZ'ABETH STU'ART, Queen of Bohemia: 1596, Aug. 19—1662, Feb. 13; b. in the palace of Falkland (q.v.): remarkable not only as a heroine, but as forming the connecting link between the ancient royal families of England and Scotland and the present reigning dynasty. On the accession of her father, James VI. of Scotland, to the crown of England which fell to him by the demise of Queen Elizabeth, 1603, she accompanied the family to England, where she was educated. She was married 1613, Feb. 14, to Frederick, Elector-Palatine, whom she soon afterward accompanied to his residence, the castle of Heidelberg (q.v.): see also PALATINATE. When the Prot. princes of Germany sought for a fitting person to fill the throne of Bohemia, they made choice of Frederick, who accepted the perilous honor, partly, perhaps, from the ambition of his wife, who is alleged to have longed for the title of queen. The Palatine removed with E. and three children to Prague, which they entered 1619, Oct. 21. Frederick and E. occupied the throne of Bohemia only about a year. By the forces of the Rom. Cath. League, the army of Frederick was routed at the battle of Prague, 1620, Nov. 8; and the royal family fled into exile, for already the Palatine was laid waste. With her husband and children, and a few faithful attendants, E. took up his residence at the Hague, and ever afterward the family lived in a state of dependence. E. was the mother of 13 children, the eldest of whom was accidentally drowned in Holland, and three others died young. The next were Charles-Louis and Rupert, and, following in order, were Elizabeth, Maurice, Edward, Philip, Louisa, Henrietta-Maria, and Sophia. From this numerous offspring, E. derived little comfort in her misfortunes. Charles-Louis was a selfish, calculating person, with low, disreputable habits. Rupert (q.v.), the 'mad cavalier,' and his brother, Maurice, fought in England during the civil war, and, after the loss of the royalist cause at the battle of Naseby they betook themselves to the sea, and for some time were little better than pirates. Edward, 1645, abjured Protestantism, and was admitted into the Ro'n. Cath. Church. Philip committed an assassination at the Hague, fled from justice, became a soldier of fortune in France, and was slain in the civil wars. Elizabeth accepted the office of superior of the Lutheran abbey of Hervorden, Henrietta-Maria was espoused by Ragotzi, Prince of Transylvania, but died shortly after her marriage. Louisa fled

ELIZABETOPOL.

to France and died as abbess of Maubisson. Previous to these events, E. became a widow by the death of Frederick, 1629, Feb. 17, when his right to the Palatinate devolved on Charles-Louis, who, by the treaty of Westphalia, was restored to the family inheritance, 1648, Oct. 24. This favorable turns of affairs did not mend the fortunes of E., who was scandalously neglected by her son, the young Elector-Palatine; and all he would do for the family was to give a shelter to his youngest sister Sophia, until she was married to Ernest-Augustus, scion of the House of Brunswick, who ultimately succeeded to the electorate of Hanover.

Deprived, in one way or other, of all her children, the Queen of Bohemia—by which title she continued to be known—resolved to quit Holland. Relieved of her debts by the sale of jewels, and by aid of a pecuniary subsidy from the British parliament, she embraced an invitation from her nephew, Charles II., to come to England. She arrived 1661, May 17. From this time she was in a great measure indebted from the hospitality of Lord Craven, in a mansion which he had purchased from Sir Robert Drury, in Drury Lane, London. Charles II. paid her little attention; but at her death, he caused her remains to be interred in Westminster Abbey. Charles-Louis, her son, died 1680, leaving a son, who died without issue, and the Palatinate then went to a distant branch of the family; he left also a daughter, Charlotte-Elizabeth, who, 1671, had married Philip, Duke of Orleans, only brother of Louis XIV., and in 1674, gave birth to a prince, who became the noted Regent of France during the minority of Louis XV. Charlotte-Elizabeth died at St. Cloud 1722. The late Louis-Philippe, king of the French, was her lineal descendant. When, in 1708, the question of succession to the crown of Great Britain was debated, it was found that all the descendants of James I. were either dead or were Rom. Catholics, except Sophia, electress of Hanover, and her family. By act of parliament, that year, the crown was accordingly secured to her, and her descendants, 'being Protestants;' and in virtue of this act of settlement, on the death of Queen Anne, Sophia would have ascended the throne, but she predeceased the queen three months, and her son became sovereign of the British realms as George I., 1714, Aug. 12. In this extraordinary and unforeseen manner did a grandson of the unfortunate queen of Bohemia become king of England, and originate the present dynasty. The *Memoirs of Elizabeth Stuart, Queen of Bohemia*, by Miss Benger, 2 vols., are an accurate and pleasing piece of biography.

ELIZABETOPOL, ā-lē-zā-vā-tō'pol: govt. of Russia, in Transcaucasia; part of the former kingdom of Georgia; bounded on the n. by Tiflis, on the e. by Baku, on the s. by Persia, on the w. by Erivan; 17,038 sq. m. The surface is mountainous in the w., level in the e., and is watered by Kur river and many small streams. Cap. Elizabetopol. Pop (1897) 888,954.

ELIZABETOPOL, ā-lē-zā-vā-to'pol, or yā-: town of Russian Transcaucasia; lat. $40^{\circ} 42'$ n., long. $46^{\circ} 20'$ e. The town

ELK.

consists of three parts, one of which is fortified with a bastioned wall. Its principal buildings are its many churches and mosques. The town is remarkable for numerous fruit-gardens and vineyards. Horticulture, the rearing of silk-worms, bees, and cattle, with agriculture and mining, are the chief occupations of the inhabitants. Pop. (1880) 18,000, principally Tatars and Armenians.

ELK, n. *elk* [AS. *elch*; Sw. *elg*; Icel. *elgr*, and *elk*], called also MOOSE, or MOOSE-DEER (*Alce alces*, var. *Americanus*); largest living species of the *Cervidae*, or deer family; native of the n. parts of Europe, Asia, and America. When full grown, it is about six ft. in height at the shoulders, and sometimes weighs 1,200 lbs. The body is round, compact, and short; the neck is short and thick, unlike that of deer in general, but thus adapted for sustaining the great weight



Elk (*Cervus alces*).

of the head and horns. The head is very large, narrow, about two ft. long. The horns in males of the second year are unbranched, not flattened, and about a foot long; as the animal becomes older, they begin to display a blade, with more numerous snags, and in mature elks the blade becomes very broad, the snag sometimes 14 on each horn; a single antler has been known to weigh about 60 lbs. The horns have no basal snag projecting forward. The ears are long, and have been compared to those of the ass. The eyes are small. The limbs are long, and very graceful. The tail is only about four inches long. The body is covered with coarse angular hair, which breaks when bent. On the neck and withers there is a heavy mane, and the throat is covered with long hair. A large goitre-like swelling under the throat of the younger elks has a very curious appearance. The hoofs of the E., like those of the reindeer and of the buffalo, are so constructed as to part widely, and to afford a better footing on soft marshy ground or on snow: they make a clattering when it runs. In running, it carries its

ELK.

muzzle forward, with the horns thrown back upon the neck, so that they may not be caught by branches. Its shoulders being higher than the croup, its common gait is a shambling trot; but it can also gallop with great rapidity. The color of the elk is brownish black, darker in winter than in summer; the limbs, the sides of the head, and the mane are of a lighter color than the body. Elks are seen sometimes in small herds, but often singly; they are now very rare in Europe, and are no longer found in parts of N. America in which they were formerly common. They formerly extended as far south as the Ohio. They are seen sometimes even on the shores of the Arctic Ocean. They delight in marshy districts and in forests. When compelled to eat grass, they must kneel to reach it: their proper food consists of the branches and foliage of shrubs and trees. They are very timid and inoffensive, except during the rutting season. A single stroke of an elk's fore-foot is sufficient to kill the strongest dog. It is also an extremely wary animal, and is with the greatest difficulty approached by the hunter. Its sense of smell is very acute, and the slightest sound excites its alarm. It is greatly prized as game, and sought after in N. America. In Sweden, its destruction is prohibited; and in Norway is placed under legal restrictions. The flesh of the elk is esteemed a good kind of venison;



Fossil Elk.

the fat is remarkably soft; the nose and the tongue are reckoned delicacies. The skin is used for a variety of purposes.

The elk is easily domesticated, and was at one time employed in Sweden for conveying couriers, being capable of travelling more than 200 m. in a day when attached to a sledge,

The elk of Ceylon is a deer of the group to which the name *Rusa* has been given.

ELK—ELL.

ELK, IRISH (*Megaceros Hibernicus*): large deer whose remains are found in the Quaternary beds, where an American species is found of equal size. It is a true deer, between the fallow and rein deer, and though abundant in Ireland, it is not peculiar to that country, being found also in England, Scotland, and on the continent of Europe. In Ireland, it occurs in the shell marl underlying the extensive turbaries. In England, lacustrine deposits and brick-clay contain its remains, and, associated with the mammoth and rhinoceros, they are found also in ossiferous caves. The most striking feature in this animal was its enormous antlers. A straight line drawn between their extreme tips in one specimen measured ten ft. ten inches. The form of the antler differs from that of any living species of deer. The beam enlarges and flattens into a palm; a brow snag exists as in the fallow-deer, but in adult specimens this bifurcates and expands somewhat as in the reindeer—a peculiarity never observed in the fallow-deer group. The antler is furnished also with a back snag. Some idea of the enormous size and weight of the antlers may be formed from the fact that, in a specimen where the head weighed $5\frac{1}{4}$ lbs., their weight was 81 lbs. To sustain this, the vertebræ of the neck and the limbs are very much larger and stronger than in any other deer. A fine and almost perfect specimen of this animal, from the Isle of Man, is in the Edinburgh Museum.

ELKESAITES: see ELCESAITES.

EL-KHARGEH, *ĕl-kăr'gé*: capital of the Great Oasis, Upper Egypt, lat. $25^{\circ} 28' n.$, long. $30^{\circ} 50' e.$ In the vicinity of the town are numerous ruins, among which are those of a temple; there is also a remarkable necropolis. Pop. 6,000.

ELKHART, *ĕlk'hărt*: city of E. co., Ind.; on the E. river; 100 m. e. of Chicago. It is the junction of what are known as the air-line and the old road of the Lake Shore railroad, also the terminus of the Chicago division. E. contains the principal shops of the Lake Shore company, comprising a large T-rail rolling mill, a machine shop with a capacity for making one engine per week beside the rebuilding of old ones, and a roundhouse that holds 62 engines. There are other machine shops; the largest horn factory in the United States; paper, flour, and starch mills; and several factories; 3 national banks (cap. \$250,000) and 1 state bank (cap. \$100,000); a high-school building that cost \$50,000, and 8 ward schools; 4 building and loan associations; 7 hotels; and 2 daily, 3 weekly, and 3 other periodicals. Pop. (1870) 3,265; (1880) 6,953; (1890) 11,360; (1900) 15,184.

ELL, n. *ĕl* [AS. *eln*; Dut. *el*; Icel. *alin*, the arm from the elbow to the tip of the middle finger, an ell: Dan. *alen*; Ger. *elle*, an ell: Gr. *ōlēnē*; L. *ulna*, the forearm: F. *aune*, an ell-measure (allied to *elbow*): comp. Gael. *uillean*, an elbow]: originally, the length of the whole arm from the end of the longest finger; the name of a measure of length for cloth, but not definite, and now little used; an English ell is 45 inches or five quarters of a yard (q.v.)—the Flemish,

ELLAGIC—ELLENBOROUGH.

27—the Scotch, 37. The Lat. *ulna* seems to have sometimes denoted also the measure between the outstretched hands. GIVE AN INCH AND HE'LL TAKE AN ELL, give a little, and he'll take more indefinitely.

ELLAGIC, a. *ĕl-lăj'ik* [F. *galle*, gall, reversed]: pertaining to or derived from gall-nuts. ELLAGIC-ACID, n. obtained by the action of oxidizing agents, as arsenic acid, iodine, water, etc., on gallie acid. It is obtained in largest quantity from the oriental bezoars. Pure ellagic acid is a light, pale yellow, tasteless, crystalline powder. It is insoluble in water, but soluble in aleohol. It was first obtained by Chevreul.

ELLAGITE, n. *ĕl'la-jit*: one of the natrolite group, found in yellowish or brownish crystalline masses, pearly on the plains of cleavage.

ELLEBORINE, n. *ĕl lĕb'or-ĕn* [L. *helleborus*, hellebore]: resin of extremely acrid taste, found in winter hellebore.

ELLENBOROUGH, *ĕl'ĕn-bür'rŭh*, Earl of (EDWARD LAW, first Earl of E.): 1790–1871, Dee. 2; son of the first baron (1750–1818, chief-justicee of the king's bench). He was edueated at Eton and St. John's College, Cambridge, where he graduated M.A. 1809; succeeded his father in the barony 1818; was lord privy seal in the Duke of Wellington's administration, 1828–29; pres. of the Board of Control during the short-lived Peel administration, 1834–35; and appointed on the return of Sir Robert Peel 1841, Sep. to the same office, which he relinquished a month afterward for the post of gov.gen. of India. He reeeived the thanks of parliament 1843 for his 'ability and judgment' in supporting the military operations in Afghanistan. In many other respects his Indian administration was open to eensure. He was charged with reserving his favor for the military, and inflicting undeserved slights upon the civil servants of the Company. He made showy progresses, addressed to the rulers and natives of India proclama-tions which appeared to sanction idolatry; and, finally, in his proelamation concerning the sandal-wood gates of the temple of Juggernaut, when brought baek from Ghuznee, he reached the climax of a series of extravagances, which induced the directors of the E. India Company to exercise a power used only in extreme cases, and to recall him. The ministry, however, stood by him, and he was created by the crown an earl and a viseount; he received also the distinction of G.C.B. In 1846, Sir R. Peel made him first lord of the admiralty, an ofifice which he resigned in July of the same year, at the disruption of the Peel administration. In the Derby administration of 1858 he was again minister for India, and the author of an Indian bill which failed to obtain the sanetion of parliament. Having permitted a dispatch to see the light, in which he had administered a severe and caustic rebuke to Viscount Canning, gov. gen. of India, an outcry was raised against him, which threatened the existence of the Derby government. To avert this result, Lord E. resigned. He afterward took a frequent and important part in the

ELLENRIEDER—ELLESMORE.

debates of the upper house. He was styled, by no less a judge than M. Guizot, ‘the most brilliant of the tory orators.’ He was twice married—first to a daughter of the Marquis of Londonderry, and secondly to the daughter of Admiral Digby. From the latter he was divorced. E. died without issue, 1871, December 2, when the earldom and viscountcy became extinct.

ELLENRIEDER, *ĕl'ĕn-rē-dĕr*, MARIE: 1791–1863, June; b. Constance: painter of high excellence. She studied in Munich, and 1820 went to Rome to perfect her knowledge of art. Her admiration of the old German masters gave a religious bent to her genius. On her return to Germany, she resided some time at Carlsruhe, where she painted a *Martyrdom of St. Stephen*, as an altar-piece for the Rom. Cath. Church. She was afterward appointed court-painter at Munich, but she chose to fix her residence at Constance, and gave herself exclusively to her profession. Among her principal pieces are the *Transfiguration of St. Barthelemy*, *Christ Blessing Little Children*, *Mary and the Infant Jesus*, *Joseph and the Infant Jesus*, *St. Cecilia*, *Faith, Hope and Charity*, and a *Madonna*. Marie E. is reckoned in Germany as the greatest female artist of the present age. So full of ideal grace and beauty are the heads of her women and children, in particular, that it has been said that ‘she seems to paint in the presence of angels;’ her coloring; however, is gray, dull and sombre, like that which prevails among the old masters of the German school.

ELLERY, *ĕl'ĕr-ĕ*, WILLIAM: 1727, Dec. 22—1820, Feb. 15; b. Newport: lawyer. He graduated at Harvard Univ. 1747; engaged in mercantile business and was naval officer of R. I.; studied law and began to practice 1770; and was chosen one of the delegates from R. I. to the continental congress, 1776, in which he signed the Declaration of Independence. Excepting 1780, '82 he served in congress till 1786; was a member of the board of admiralty; drew up the plan for the creation of the dept. of state; seconded Rufus King's motion for the abolition of slavery 1785; was commissioner of the loan-office of R. I. 1786, and chief justice of the superior court of R. I.; and was appointed collector of Newport 1790, and held the office till his death.

ELLESMORE, *ĕlz'mĕr*: town in the n.w. of Shropshire, England, near a beautiful lake or mere, 19 m. n.n.w. of Shrewsbury. It has considerable malting establishments. On the present site of a bowling-green once stood an ancient castle, alternately held by the English and Welsh. Pop. of E. (1881) 1,875; (1891) 1,830.

ELLESMORE, first Earl of (FRANCIS EGERTON): politician, patron of the arts, and author, 1800–57; second son of the first Duke of Sutherland. He graduated at Christ Church, Oxford, 1820; entered the house of commons, 1820, and represented successively Bletchingly, Sutherland county, and s. Lancashire; filled the office of chief sec. for Ireland and then of sec. at war; in 1833 assumed the name of Lord Francis Egerton, in lieu of his patron-

ELLET—ELLICOTT.

nymic Leveson-Gower. He achieved considerable literary distinction as a writer of graceful poems, translations from the German, etc. He also published a pamphlet on the defenseless state of the coasts of the metropolis, which called forth some adverse criticism. He was a munificent patron of the arts, and made many valuable additions to the collection of pictures which he inherited with the large estates of the last Duke of Bridgewater. He also built a noble gallery for their reception, which he liberally threw open to the public. After faithfully voting with the conservative party in parliament for a quarter of a century, he, on the retirement of the Peel administration, 1846, obtained a revival in his favor of the peerages of Ellesmere and Brackley. He died at his new mansion, Bridgewater House, London, and was succeeded in the Earldom by his eldest son, Viscount Brackley.

ELLET, *ĕl'ĕt*, CHARLES: 1810, Jan. 1—1862, June 21; b. Penn's Manor, Bucks co., Penn.: engineer. He studied engineering while employed in the construction of the Chesapeake and Ohio canal, and afterward in the Polytechnic School, Paris. He became chief engineer of the James River and Kanawha canal; built the first wire suspension bridge in the United States over the Schuylkill river in Philadelphia 1842; designed and built the railroad suspension bridges over the Niagara river below the falls 1847, and over the O. river at Wheeling W. Va.; improved the navigation of the Kanawha river; and assisted in laying out the Baltimore and O. railroad. At the beginning of the civil war he prepared plans for the construction of steel rams for river service, which were rejected by the navy dept. and adopted by the war dept.; was commissioned col. of engineers in the army; converted 9 river steamboats into a fleet of rams and with them defeated a Confederate squadron in the Mississippi river off Memphis 1862, June 6; and received a wound during the battle from which he died.

ELLICOTT, *ĕl'ĕ-kĕt*, ANDREW: 1754, Jan. 24—1820, Aug. 29; b. Bucks co., Penn.: engineer. He received a scientific and mechanical education; marked the boundaries of Va., Penn., and N. Y.; removed to Baltimore and was elected a member of the legislature; surveyed the land between Penn. and Lake Erie; and made, 1789, the first complete measurement of the Niagara river with the height of the falls and the descent of the rapids. In 1790 he was commissioned to survey and lay out the city of Washington; 1792 was appointed surveyor-gen. of the United States; 1795 superintended the construction of Fort Erie; 1796 was commissioner to determine the boundary between the United States and the Spanish possessions on the south; and 1812 became prof. of mathematics in the U. S. Milit. Acad., and held the office till death. He conducted a series of astronomical observations in Montreal to carry out some provisions of the treaty of Ghent, 1817. He was a member of the American Philosophical Soc., a corresponding member of numerous scientific organizations, American and

ELLICOTT—ELLIOTT.

foreign, and an intimate friend of Washington, Franklin, Rittenhouse, and other fathers of the republic.

ELLICOTT, *ĕl'ĕ-kot*, CHARLES JOHN, Bishop of Gloucester and Bristol, England: b. 1819, Apr. 25, near Stamford, of which parish his father was rector. He studied at Cambridge, where he graduated 1841, and obtained many honors. He became prof. of divinity at King's College, London, 1848, and at Cambridge 1859. He was named Dean of Exeter 1861, and raised to the Episcopal bench 1863. He is best known as a commentator on the Epistles of the New Testament, and is distinguished for thoroughness of grammatical criticism. He has published critical and grammatical commentaries on Galatians, Ephesians, Philippians, Colossians, Thessalonians, Philemon, and the Pastoral Epistles; works on the Sabbath, on Scripture and its Interpretation, and on skepticism.

ELLIOT, *ĕl'ĕ-ot*, EBENEZER, the CORN-LAW RHYMER: 1781, Mar. 7—1849, Dec. 1; b. Masborough, Yorkshire, England. His father was a man of strong character and narrow opinions, and, as appears from Ebenezer's Autobiography (published in the *Athenaeum* 1850), exercised no little influence on his son's modes of thinking and sympathies. When a boy at school, E. was not a quick pupil; and even after his father had sent him to work in the iron-foundry where he himself held the situation of a clerk, the youth exhibited no fondness for reading. Before long, however, he entirely changed, and began to study Milton, Shakespeare, Ossian, Junius, and other authors. His first published poem was composed in his 17th year; it is entitled *The Vernal Walk*. This was succeeded by *Night*, *Wharncliffe*, etc. In 1821, E. began business as an iron-founder on his own account at Sheffield. He was very successful; and in 1841 retired to an estate which he had purchased at Great Houghton, near Barnesley, where he died. E.'s principal productions are *Love*, accompanied with a letter to Lord Byron, his famous *Corn-law Rhymes*, *The Ranter*, and *The Village Patriarch*, a work full of noble and earnest poetry, all of which appeared 1823-30. In 1834, he issued a collected edition of his works, 3 vols.; and in 1840, an edition in one volume. E. followed Crabbe, but with more depth and fire of feeling, in depicting the condition of the poor as miserable and oppressed, tracing most of the evils that he deplores to the social and political institutions of the country. The laws relating to the importation of corn were denounced by E. as specially oppressive, and he inveighed against them with a fervor of manner and a harshness of phraseology repulsive to ordinary minds. But the glow of earnestness kindles his verse, and hides a multitude of faults. More enduring, however, than his rhyming philippics are his descriptions of English, especially of Yorkshire scenery, and his delineations of humble virtue and affection. These are instinct with the purest spirit of poetry.

ELLIOTT, *ĕl'ĕ-ot*, CHARLES, D.D., LL.D.: 1792, May 16—1869, Jan. 6; b. Greencanway, co. Donegal, Ireland;

ELLIOTT—ELLIPSE.

clergyman. At an early age, he joined the Wesleyan Church, was educated according to the curriculum of the Univ. of Dublin, came to the United States 1815, and was admitted to the O. conference of the Meth. Episc. Church 1818. Soon afterward he was appointed supt. of missions among the Wyandotte Indians at Upper Sandusky, O., and 1827-31 was prof. of languages in Madison College, Uniontown, Penn. In the latter year he removed to Pittsburg, where he became presiding elder of the district, editor of the *Pittsburg Conference Journal*, and editor of the *Western Christian Advocate*, conducting the latter till 1848 and 1852-56. He was chosen pres. and prof. of Biblical literature in Io. Wesleyan Univ. 1856, resigned 1860, became editor of the *Central Christian Advocate* at St. Louis, and was again pres. and prof. 1864-67. His publications include *Treatise on Baptism* (1834); *Delineation of Roman Catholicism*, 2 vols. (1851); *Life of Bishop Roberts* (1853); *History of the Great Secession from the Methodist Episcopal Church* (1855), *Political Romanism* (1859), *Reminiscences of the Wyandotte Mission, Southwestern Methodism*, and *The Bible and Slavery*.

ELLIOTT, ē'l'i-ot, CHARLES LORING: 1812, Dec.—1868, Sep. 25; b. Scipio, N. Y.: portrait painter. He studied drawing and painting while a clerk in Syracuse; removed to New York 1834; studied painting with Trumbull and Quidor; achieved fame first by painting a series of pictures based on scenes described by Washington Irving and James K. Paulding; spent several years painting portraits in w. N. Y.; and became an associate of the National Acad. 1845, and an academician 1846. His portraits of eminent men of his time are said to exceed 700 in number, and are noted for fidelity of likeness.

ELLIPSE': figure in geometry, important from its being the approximate shape of the planetary orbits. It is a curve of the second order, and is a conic section, formed by cutting a right cone by a plane passing obliquely through its opposite sides. It may be defined as a curve, the sum of the distances of every point in which from two fixed points within the curve is always the same. These two fixed points are called the foci; and the diameter drawn through them is the major axis; the minor axis bisects the major at right angles. The distance of either focus from the middle of the major axis is the eccentricity. The less the eccentricity is as compared with the axis, the nearer the figure approaches to a circle; and a circle may be considered as an ellipse whose foci coincide.

There are various contrivances for describing an ellipse, called ellipsographs or *elliptic compasses*. The simplest method of description is to fix on a plane the two ends of a thread with pins in the foci, and make a pencil move on the plane, keeping the thread constantly stretched. The end of the pencil will trace an ellipse, whose major axis is equal to the length of the thread.

The equation to an ellipse (see CO-ORDINATES), referred to its centre as origin, and to its major and minor axes as

rectangular axes, $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, where a and b are the semi-major and semi-minor axes respectively. From this equation, it may be shown, by the integral calculus, that the area of an ellipse is equal to πab ; or is got by multiplying the product of the semi-major and semi-minor axis by 3·1,416. It may be shown also that the length of the circumference of an ellipse is got by multiplying the major axis by the quantity $\pi \left(1 - \frac{d^2}{2^2} - \frac{3d^2}{2^2 \cdot 4^2} - \frac{3^2 \cdot 5d^2}{2^2 \cdot 4^2 \cdot 5^2} - \text{etc.}\right)$, where $d = \frac{1 - 4b^2}{4a^2}$.

ELLIPSIS, n. *ĕl-lip'sis*, ELLIPSES, n. plu. *-sēz*, or **ELLIPSE**, *-lip's*, ELLIPSES, n. plu. *-sēz* [L. *ellipsis*; Gr. *elleipsis*, an omission or defect—from Gr. *leipō*, I leave]: an oval figure; a figure formed by cutting a cone or sugar-loaf in an oblique direction across its length. **ELLIPSIS**, in a *sentence*, the omission of a word or words obviously understood, and necessary to complete the sentence in its usual form: the object is to secure brevity. The ellipsis is found in all languages. One kind, probably peculiar to the English language, is illustrated by the expression, ‘the house we saw,’ for the house *that* we saw; frequently used but of questionable propriety because of its liability to ambiguity. **ELLIP'SOGRAPH**, n. *-sō-grāf* [Gr. *graphō*, I write]: an instrument for describing a semi ellipse. **ELLIP'SOID**, n. *-soyd* [Gr. *eidos*, form]: a figure or solid formed by the revolution of an ellipse about its axis. It is a surface of the second order, of which the spheroid (q.v.) is a species, and the most interesting, from the fact of the form of the earth being spheroidal. The equation to an ellipsoid referred to its centre and rectangular co-ordinates is $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$. **ELLIP'SOID**, a. *-soyd*, or **EL'LIPSOI'DAL**, a. *-soy'dal*, pertaining to. **ELLIP'TIC**, a. *-tīk*, or **ELLIP'TICAL**, a. *-tī-kāl*, having the form of an ellipse; approaching the form of an ellipse; defective; having a part understood. **ELLIP'TICALLY**, ad. *-tī*. **EL'LIPTIC'ITY**, n. *-tīs'i tī*, the fraction that indicates the deviation of an ellipse from a sphere or circle. **ELLIPTICITY OF THE EARTH**: see **EARTH**.

ELLIS, *ĕl'is*, ALEXANDER JOHN, F.R.S., F.S.A.: b. Horton, England, 1814. He was educated at Shrewsbury, Eton, and Trinity College, Cambridge, taking his B.A. degree 1837. His name by birth was Sharpe, which was changed by royal license 1825. He was elected a Fellow of the Royal Soc. 1864, and of the Soc. of Antiquaries 1870. He was pres. of the Philological Soc. 1872–74, and is a member of the Philosophical and Mathematical Societies of London. Among his numerous and valuable works are: *Alphabet of Nature* (1845); *Essentials of Phonetics* (1848); *Universal Writing and Printing* (1856); *Early English Pronunciation* (1869–1871); *Practical Hints on the Quantitative Pronunciation of Latin* (1874); translation of Helm-

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holtz's *Sensations of Tones as a Physiological Basis for the Theory of Music* (1875); contributions to *Chambers's Encyclopedia* (new edition).

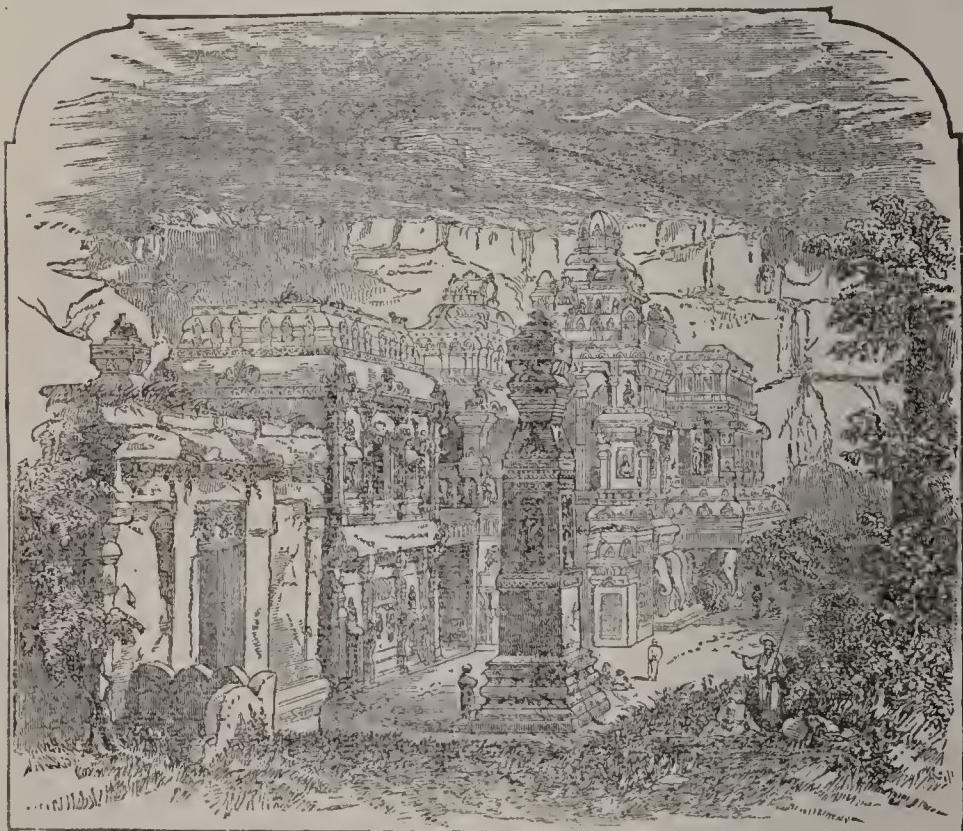
ELLIS, *ĕl'īs*, GEORGE EDWARD, D.D., LL.D.: 1814, Aug. 8—1894, Dec. 20; b. Boston: educator. He graduated at Harvard Univ. 1833, and at its divinity school 1836, was ordained pastor of the Harvard Unit. Church, Charlestown, Mass., 1840, Mar. 11, and was prof. of systematic theol. in Harvard Divinity School 1857–63. He was a Lowell Institute lecturer on *Evidences of Christianity* 1864, on *Provincial History of Massachusetts* 1871, and on *The Red Man and the White Man in North America* 1879. In 1850–54 he was an overseer of Harvard Univ.; 1869 resigned his pastorate; and 1887 became pres. of the Mass. Historical Soc. His publications, memoirs, histories, sermons, and addresses are very numerous; and he was a frequent contributor to the *Encyclopedias Britannica*, other similar publications, and the religious and secular press. He wrote a number of lives for Sparks's *American Biography*, and several chapters for the *Memorial History of Boston* and the *Narrative and Critical History of America*. He received the degrees D.D. (1857) and LL.D. (1883) from Harvard Univ., being the fourth person who received both from it.

ELLIS, WILLIAM: 1795–1872: eminent missionary. In 1816, he sailed with his wife for the South Sea Islands, sent by the London Missionary Soc. (Congl.), and labored there nearly ten years. He set up in Tahiti the first printing-press in the South Sea Islands. In 1824, he returned to England, on account of the illness of his wife. He was for some years employed at home in the business of the London Missionary Society. In 1826, he published a *Narrative of a Tour through Owhyhee*; and in 1829, *Polynesian Researches*, 2 vols. In 1839, he published a *History of Madagascar*, 2 vols., compiled from government papers, and information received from missionaries. In 1835, his wife died, and two years afterward he married Miss Sarah Stickney, who for many years conducted a school for girls at Hoddesdon, in Hertfordshire, and who is well known as the authoress of many popular works, among which are *The Women of England* (1838), *The Daughters of England* (1842), *The Wives of England* (1843), *Hearts and Homes* (1848–9), and *The Mothers of Great Men* (1859). Her works have been widely circulated in Britain and America. She was educated among the Society of Friends, to which her parents belonged.—In 1853, Mr. E. was sent to Madagascar by the London Missionary Soc., to inquire into the state of things in that island, and particularly into the condition and prospects of the Christians there. In 1859, he published an interesting and valuable work, entitled *Three Visits to Madagascar, during 1853–56, with Notices of the People, Natural History, etc.*, a work of great general interest, to which the western world is largely indebted for information concerning that island. In his *Polynesian Researches*, as well as in this work, Mr. E. gives much information concerning the inhabitants, scenery, and produc-

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tions of the countries which he visited. In 1867, he published *Madagascar Revisited, describing the Events of a New Reign, and the Revolution which followed, setting forth also the Persecutions endured by the Christians, and their Heroic Sufferings, with Notices of the Present State and Prospects of the People.*

ELLORA, *ĕl-lō'rā*: decayed town in the dominions of the Nizam, not far from the city of Dowlatabad; lat. $20^{\circ} 2' \text{ n.}$, and long. $75^{\circ} 13' \text{ e.}$ It is celebrated for its wonderful rock-cut temples. Their number has not been precisely ascertained, but Erskine reckoned 19 large ones, partly of Hindu and partly of Buddhist origin. Some are cave-temples proper—i.e., chambers cut out in the interior of the rock—but others are vast buildings hewn out of the solid granite of the hills, having an exterior as well as an interior architecture, and being, in fact, magnificent mon-



Temple called Kailasa, at Ellora.—From *Ferguson's Handbook of Architecture*.

oliths. In executing the latter, the process was, first to sink a great quadrangular trench or pit, leaving the central mass standing; and then to hew and excavate this mass into a temple. The most beautiful of these objects is the Hindu temple, Kailasa. At its entrance, the traveller passes into an antechamber 138 ft. wide by 88 deep, adorned by numerous rows of pillars. Thence he proceeds along a colonnade over a bridge into a great rectangular court, 247 ft. in length and 150 broad, in the centre of which stands the temple itself, a vast mass of rock richly hewn and carved. It is supported by four rows of pilas.

ELLORE—ELLSWORTH.

ters, with colossal elephants beneath, and seems suspended in the air. The interior is about 103 ft. long, 56 broad, and 17 high, but the entire exterior forms a pyramid 100 ft. high, and is overlaid with sculpture. In the great court are numerous ponds, obelisks, colonnades, sphinxes, and on the walls thousands of mythological figures of all kinds, 10 to 12 ft. in height. Of the other temples, those of Indra and Dumarheyna are little inferior to that of Kailasa. Regarding their antiquity and religious significance, authorities are not agreed; but at all events they must be subsequent to the epic poems *Ramayana* or *Mahabharata*, because they contain representations taken from these poems; also to the cave-temples at Elephanta, because they exhibit a richer and more advanced architecture.

ELLORE, *ĕl-lōr'*: town of the dist. of Godavari, province of Madras; lat. $16^{\circ} 42' n.$, and long. $81^{\circ} 10' e.$ E. was formerly an important military station, and has at present carpet manufactures. The town occupies both banks of the Jummulair, a torrent of the Eastern Ghauts, which, instead of reaching the Bay of Bengal, loses itself three m. further down, in the land-locked Colair Lake. In fact, for about 50 m. to the westward of the sea, the neighboring country is depressed below the level of the maritime belt, the stagnant pool above mentioned not only having independent feeders of its own, but receiving supplies also, in the season of high-water, from the Kistnah or Krishna, and the Godavery. Under such circumstances, the climate of E. is unpleasant and unhealthful. During the s. w. monsoon, bringing the accumulated heats of the whole breadth of the peninsula, the temperature is particularly oppressive, having been known to rise, in the night, to $120^{\circ} F.$.—Pop. about 30,000.

ELLSWORTH, *ĕlz'wĕrth*: city and port of entry of Maine; seat of justice of Hancock co. It lies on both sides of the navigable river Union, 28 m. s.e. of Bangor, about 4 m. w. of Frenchman's Bay. It is an attractive place, with active trade, exporting 50,000,000 ft. of timber annually, and carrying on cod and mackerel fisheries. Pop. (1880) 5,052; (1890) 4,804; (1900) 4,297.

ELLSWORTH, *ĕlz'wĕrth*, **EPHRAIM ELMER**: 1837, Apr. 23—1861, May 24; b. Mechanicsville, N. Y.: soldier. He removed to Chicago at an early age, studied law, became a solicitor of patents, and organized a regt. of zouaves, which as col. he drilled to a remarkable degree of perfection in discipline and milit. tactics. He escorted Pres.-elect Lincoln to Washington 1861, Mar., and at the outbreak of the civil war hastened to New York and raised a zouave regt. exclusively of firemen, of which he was commissioned colonel. His regt. reached Washington in time to extinguish a fire in Willard's hotel that had got beyond the control of local firemen, and then crossed the river and took possession of Alexandria. Noticing a Confederate flag flying over the Marshall House, a hotel owned by a man named Jackson, he went to the roof, tore the flag down, and as he was descending the stairs was shot dead by the

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proprietor, who in turn was killed on the spot by Frank Brownell, one of the zouaves who had rushed in after Col. E. The event created intense excitement at the time, as E. was the first officer of his rank killed in the war.

ELLSWORTH, OLIVER, LL.D.: 1745, Apr. 29—1807, Nov. 26; b. Windsor, Conn.: lawyer. He studied at Yale and Princeton Colleges, graduated at Yale, 1766, studied theol. a year, then applied himself to law, and was admitted to the bar 1771. In 1775 he was appointed attor.gen. of Conn.; at the beginning of the revolutionary war was elected a member of the gen. assembly; 1777 was chosen a delegate to the continental congress; served in congress till 1783, June; and was a member of the governor's council 1780-84. He declined the office of commissioner of the treasury 1784, accepted that of judge of the superior court of Conn. the same year, and was a member of the convention that framed the federal constitution 1787. He was elected U. S. senator for the first congress under the new form of govt., was chairman of the committee on the organization of the judiciary, and drafted the bill providing for its creation and defining its functions. After brilliant service as debater, economist, and supporter of Washington's administration, he was appointed chief-justice of the U. S. supreme court 1796, Mar., and served till 1799, when, on the recommendation of the senate, he was appointed with Patrick Henry and William R. Davie an extraordinary commission to negotiate a treaty with France. In this he was eminently successful. Owing to impaired health he resigned the chief justiceship 1800, and spent some time abroad. He subsequently became a member of the governor's council; and was appointed chief-justice of the Conn. supreme court, but died without serving. He received the degree LL.D. from Yale College 1790, and from Dartmouth and Princeton 1797.

ELM, n. *ēlm* [Dut. *olm*; Icel. *almr*; Dan. *alm*; L. *ulmus*, an elm], (*Ulmus*): genus of trees of the nat. ord. *Ulmaceæ*, natives of temperate climates, with serrated leaves unequal in their two sides, and small flowers growing in clusters appearing before the leaves, and containing 4-12 stamens and one german. The fruit is a samara, or compressed one-seeded little nut, winged all around. ELMY, a *ēl'mī*, abounding in elms.—One of the most important species of Elm is the COMMON SMALL-LEAVED or ENGLISH ELM (*U. campestris*), 60-80 ft. in height, with ovato-elliptic, doubly serrated leaves, and flowers almost destitute of stalks. The wood is compact, and very durable in water. The tree is diffused over Europe; is found also in the w. of Asia and n. of Africa, and is used for a great variety of purposes by wheelwrights, machine-makers, ship and boat builders, etc.; it is also prized by joiners for its fine grain, and the mahogany color which it readily assumes on the application of an acid. It is reckoned superior to the wood of any other species of elm. The bark is used in dyeing, and in sugar-refining, and, in times of scarcity, has been used in Norway for grinding into meal and mixing in bread, which

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has a less disagreeable taste than that made from meal mixed with fir-bark. The inner bark is used medicinally in cutaneous diseases; it is mucilaginous, and has a bitter astringent taste. The ELM BALSAM (*Beaume d'orme*), formerly in great repute, is a brownish substance found in dried galls of the leaves in the s. of Europe, Persia, etc. From these galls, in an earlier stage, flows a clear, viscid, sweetish liquid, called Elm Water (*Eau d'orme*), used for washing wounds, contusions, and sore eyes.—The seeds of the elm are eagerly eaten by pigeons and common poultry. The elm is one of the principal timber trees and one of chief ornaments of scenery.—The CORK-BARKED ELM (*U. suberosa*), by many regarded as a variety of *U. campestris*, is a European tree, distinguished by the corky wings of the bark of the branches. It is a taller and more spreading tree, with much larger leaves.—The DUTCH CORK-BARKED ELM (*U. major*) also is looked upon by many as a variety

of *U. campestris*. It is still more corky in its bark, and has still larger leaves. It is of very quick growth, but the wood is inferior.—The BROAD-LEAVED OR WYCHE ELM (*U. montana*) is the only species that can with certainty be regarded as indigenous to Scotland. It has rough and broad leaves, a stem less upright than the English elm, and large spreading branches. The wood is used for all the purposes of the English elm. The tree is of very quick growth. Protuberances of gnarled wood are not unfrequently produced, which are finely knotted and richly veined; they



Common English Elm (*Ulmus Campestris*).

are much esteemed for veneering, and are sometimes very valuable. Varieties of this species are known as the GIANT ELM and CHICHESTER ELM.—The SMOOTH-LEAVED ELM (*U. glabra*), by some regarded as a variety of *U. Montana*, is distinguished, besides other characters, by smooth leaves, which are much smaller. It is a native of England. A variety called the HUNTINGDON ELM is much esteemed.—The CORNISH ELM (*U. stricta*), found in the s.w. of England, is remarkable for its rigid, erect, and compact branches.—Very different is the habit of *U. effusa*, a continental species with a large spreading

EL-MAHDI—ELMIRA.

head and smooth bark, distinguished also by the long stalks of its flowers and its ciliated fruit.—The AMERICAN or WHITE ELM (*U. Americana*), which abounds in New England, the Middle States, and the northern basin of the Mississippi, and attains its loftiest stature between lat. 42° and 46° , is a magnificent tree, sometimes 100 ft. in height, the trunk reaching 60 or 70 ft. before it separates into branches, and the widely diffused pendulous branches floating gracefully in the air; but the timber is not much esteemed.—The RED or SLIPPERY ELM (*U. fulva*), also found in New England and the Western States, and common in the basin of the Mississippi as far south as lat. 31° , and in the w. parts of Canada, attains a height of 50 or 60 ft. The wood is more valuable than that of the last species, but much inferior to the English elm. The leaves and bark yield an abundant mucilage, which is bland and demulcent, and esteemed a valuable remedy in catarrh, dysentery, and other complaints.—The WAHOO or WINGED ELM (*U. alata*) is a small tree, found from lat. 37° to Fla., La., and Ark., remarkable for the branches being furnished on two opposite sides with wings of cork. The wood is valuable.—The CORKY WHITE E. (*U. racemosa*), N. England to Wis. and s., has corky ridges and racemed flowers. *U. crassifolia*, of the s.w., has very small, thick leaves.

The name SPANISH ELM is given in the W. Indies to a tree also called Bois de CHYPRE, *Cordia Gerascanthus*, of the nat. ord. *Cordiacæ*, the timber of which is valuable, also to *Hamelia ventricosa*, of the nat. ord. *Rubiaceæ*, the timber of which is known to cabinet-makers as Prince-wood.

ELM-GALLS, n. galls on the different species of elm, produced by the bark or leaves being punctured by the *Aphis Ulmi*.

EL-MAHDI: see MAHDI, EL.

ELMINA, *ĕl-mē'nā*: fortified town and seaport of w. Africa, formerly cap. of the Dutch settlements on the Gold Coast; in an undulating and thickly wooded district, lat. $5^{\circ} 10'$ n., and long. about $1^{\circ} 40'$ w. It is large, irregularly built, and destitute of noteworthy architectural features. The inhabitants consist chiefly of traders, fishermen, and artisans. A few miles to the e. is Cape Coast Castle. E. was established by the Portuguese 1481, the first European settlement on the coast of Guinea. It was taken by the Dutch 1637, and, four years later, was ceded to them by Portugal. It was ceded to the British 1872, and destroyed by them 1874, during the Ashantee war. Pop. 6,000.

ELMIRA, *ĕl-mī'ra*: city, cap. of Chemung co., N. Y.; on both sides the Chemung river; on the Erie railroad at the intersection of the Northern Central, and at terminus of the Utica Ithaca and E. railroad; 46 m. s.w. of Ithaca, 78 m. n. by e. of Williamsport, 149 m. e.s.e. of Buffalo, 274 m. w.n.w. of New York. It is the largest city in that part of the state, is beautifully laid out, has a fine water supply, is lighted by gas and electricity, and beside its river and

ELMO'S FIRE—ELMSHORN.

railroad facilities has a valuable commercial outlet in the Chemung canal, which connects it with Seneca Lake. In 1900 it had 362 mfg. establishments, using a capital of \$7,365,534, employing 4,914 hand, paying in wages \$1,965,056, and yielding products valued at \$8,558,786. The chief industries are the large shops of the Erie and the Northern Central railroads; a rolling mill and blast furnace, each with a capital of \$1,500,000; 10 boot and shoe factories; three iron foundries; the manufacturing and repairing shops of the Pullman Car Company; a woolen mill; a steam fire-engine manufactory; several tanneries; a flour mill; and a carriage factory. Next to the iron and coal interest, the wholesale grocery trade is the most extensive, and after that the dry-goods trade. The public buildings include a state reformatory, co. courthouse, city hall, jail, orphan's home, home for the aged, and an industrial school; the educational, the E. Female College (Presb.), endowment \$100,000, library of more than 3,000 vols., a Rom. Cath. Acad., the E. Free Acad., a high school, normal school, and six grammar and graded schools; and the religious, 24 churches divided denominationally as follows: Meth. Episc. six, Bap., Presb., and Rom. Cath. each four, Prot. Episc. and Jews each two, and Congl. and German Evang. each one. The masonic fraternity has a temple that cost \$150,000, in which the post office is located, and the Odd Fellows have another. A notable building is the Arnat-Ogden Memorial Hospital. There are 5 hotels, a national bank (cap. \$300,000), a state bank (cap. \$100,000), a savings and two private banks; a public and 6 other libraries, 2 building and loan associations, and 3 daily, 5 weekly, and 6 other periodicals. In 1902 the city had a total assessed valuation of \$17,393,988, a total bonded debt of \$1,113,000. Large mines of the McIntyre Co., which to a great extent furnish the coal supply of the New York Central and Hudson River railroad, are but 20 m. s. of E., and the Blossburg soft-coal field about the same distance s.w. There are several quarries of excellent stone just beyond the city limits. During the civil war E. was noted for its great recruiting rendezvous and its military prison, in which a large number of Confederate prisoners were confined. It was incorporated 1865. Pop. (1870) 15,863; (1880) 20,541; (1900) 35,672.

ELMO'S FIRE, *ĕl'mōz*, St.: popular name of an appearance sometimes seen, especially in southern climates during thunder-storms, of a brush or star of light at the tops of masts, spires, or other pointed objects. It is sometimes accompanied by a hissing noise, and is evidently of the same nature as the light caused by electricity streaming off from points connected with an electrical machine: see **ELECTRICITY**. The phenomenon, as seen at sea, was woven by the Greeks into the myth of Castor and Pollux; and even yet such lights at the mast-head are considered by sailors a sign that they have nothing to fear from the storm.

ELMSHORN, *ĕlms'hōrn*: town in the Prussian province of Schleswig-Holstein, 20 m. n.w. of Hamburg; on both

EL-OBEID—ELOHIM.

banks of the Krückau, a navigable stream, and feeder of the Elbe. It is well built, has considerable manufactures and an active trade in grain; it has also a boat-building yard and some tanneries. Vast numbers of boots and shoes are made at E., and sold at all the fairs in the country around. Many Jews reside here, as this was one of the few places in Schleswig or Holstein in which they were allowed to settle without previous permission. E. has an important annual cattle-market. Pop. (1880) 7,956 ; (1890) 9,803.

EL-OBEID: see EL-OBEID

ELOCUTION, n. *ěl'ō-kū'shūn* [L. *elocutio*nem, oratorical delivery—from *e*, out of; *locutus*, spoken: F. *élocution*: It. *elocuzione*]: management and quality of the voice in the utterance or delivery of words; fluency of speech; style or manner of speaking, as distinguished from the wider art of oratory which takes account also of the matter spoken. Prominent in ancient education, it has been much neglected in modern times: see READING AND SPEAKING. EL'OCU'TIONARY, a. -ér-í, relating to elocution. EL'OCU'TIONIST, n. -ist, one versed in, or who treats of, elocution.—SYN. of 'elocution': eloquence; oratory; rhetoric.

ELODÆ, n. *ě-lō'dē a* [Gr. *helōdēs*, marshy, fenny, the habitat of these plants being in such places]: in bot., genus of *Hypercaceæ*, typical of the tribe *Elodeæ*.

ÉLOGE, n. *ā-lōzh'* [F. *éloge*, a eulogy—from L. *elogium*, a short saying or maxim]: eulogy; a panegyric; an oration in honor of a deceased person. When a member of the French *Académie* dies, it is customary for his successor to deliver an oration, setting forth his merits and services. This is called an *éloge*, and a considerable branch of French literature goes by the name. Many of the French *éloges* are mere florid panegyrics; but others, particularly those written by Thomas, D'Alembert, Bailly, Condorcet, Cuvier, and other eminent savants, are interesting and valuable biographies. The proper epoch of the *éloge* began with Fontenelle (2 vols. Par. 1731), who was distinguished for clearness, ease, and elegance. His successors have tried to outshine him in pomp of language. ELOGIUM, n. *ě-lō'jī-ūm*, or ELOGY, n. *ěl'ō-jī*, a funeral oration—same as *éloge*. EL'OGIST, n.-jist, one who pronounces an elegy.

ELOHIM, *ěl-ō'hím* [Heb., plural of *Eloāh*, Arab. *Ilāh*, Chald. *Elāh*, Syr. *Alōh*, might, power; in plu., intensified, collective, highest power—great beings, kings, angels, gods, *Deity*]: one of the Hebrew names for God. As a *pluralis excellentiae* or *majestatis*, and joined to the singular verb, it denotes, with very rare exceptions, *the One*, true God. Joined to the plural verb, however, it usually means gods in general, whether including the One or not. It is mostly used (in the singular sense) for or together with Jehovah (the Everlasting One); but some portions of the Scriptures employ exclusively either the one term or the other. This fact has given rise to endless discussions, and has also suggested among others the notion of different authors of Genesis. On this, and on the relation of those two words to each other, see JEHOVAH:

ELOHIST—EL PASO.

GENESIS: PENTATEUCH. The opinion of the Talmudists, seemingly unnoticed until recently, was that E. denotes the Almighty under the aspect of a God of strict justice; Jehovah, of clemency and mercy. As important for the history of the word E., it is noticeable that it was probably Petrus Lombardus who first tried to prove the Trinity out of this plural form—an attempt which, though unanimously and scornfully rejected by all scholars, from Calvin, Mercerus, Calixtus, the younger Buxtorf, etc., to our times, has lately been revived by Rudolf Stier, who has gone so far as to invent a new grammatical term, '*Pluralis Trinitatis*,' for this purpose. See (besides the titles above) SHEMITIC PLURAL.

ELOHIST, n. *ēl-ō'hist* [Heb. *Elōhim*, a name of God]: the writer, or one of the writers, who is supposed to have introduced the name *Elohim* into certain passages of the O. Test., notably those of the Pentateuch, rather than *Jehovah* as the name for *God*; a Divine name as distinguished from *Jehovah*. **ELOHISTIC**, a. *ēl-ō-hi'stik*, relating to the *Elohim*, as a name of God, said of passages in the O. Test. Scrip.: see ELOHIM.

ELONGATE, v. *ē-lōng'gāt* [mid. L. *elongātus*, made long—from *e*, out of; *longus*, long]: to extend; to lengthen; to draw out; to go farther off. **ELONGATING**, imp. **ELONGATED**, pp. **ELONGATION**, n. *ē'lōng-gā'shūn*, the act of lengthening; extension; continuation; departure; apparent distance of a planet from the sun. **ANGLE OF ELONGATION**, angle measuring the distance between two stars, as seen from the earth; usually employed in speaking of the distance only of planets from the sun; the word 'distance' being used instead of the word elongation, in regard to fixed stars and planets, as related to one another.

ELOPE, v. *ē-lōp'* [Dut. *ontlopen*, to evade, to escape: Icel. *hlaupa*; Dut. *loopen*, to run: Norw. *laupast*, to run away]: to run away privately; to run away from the house of a father, husband, or guardian without leave, in company with another person. **ELOPING**, imp. **ELOPED'**, pp. *-lōpt'*. **ELOPE'MENT**, n. *-mēnt*, the private departure from a house without leave, as of a wife from a husband with another man (see ADULTERY), or more usually, as of a young woman from her parents or guardians in order to be married without their consent.

ELOQUENT, a. *ēl-ō-kwēnt* [F. *éloquent*—from L. *eloquēntem*, eloquent—from *e*, out of; *loquor*, I speak: It. *eloquente*]: forcible and powerful in the use of appropriate language; fluent; persuasive. **ELOQUENTLY**, ad. *-lī*. **ELOQUENCE**, n. *-kwēns* [F.]: persuasive speech; the fluent use of forcible and elegant language in public speaking; the power of expressing strong emotions in striking and beautiful language; oratory: see RHETORIC: READING AND SPEAKING.

EL PASO: *ēl pā sō*: city, port of entry, and capital of El Paso co., Tex.; on the Rio Grande river about 1,420 m. from its mouth in the extreme w. of Tex.; on the Atchison Topeka and Santa Fé, Texas Pacific, and Southern Pacific r.rs. The Mexican Central starts here. Near here

ELPHINSTONE—ELSASS.

is the famous El Paso del Norté (pass of the north), 3,800 feet above the sea, and on the opposite bank of the river the Mexican town of Ciudad Juarez. There are extensive vineyards in the vicinity, and the wine trade is important. The city has a large meat refrigerating plant, ice factories, electric and gas light, churches, five schools, a fine U. S. govt. building, 4 daily and 4 weekly newspapers, 1 state and 1 national bank (cap \$100,000). Pop. (1880) 736; (1890) 10,338; (1900) 15,906.

EL'PHINSTONE, WILLIAM: 1430 (or 31)—1514, Oct. 25; famous Scottish prelate, founder of King's College, Aberdeen; son of William E., Canon of Glasgow and Arch-deacon of Teviotdale, and, as marriage of ecclesiastics was prohibited, his birth was illegitimate. E. took his degree M.A. at the University of Glasgow, at the age of 24, at the same time taking priests' orders. From his 29th year he spent 9 years on the continent in the study of law, and gained appointment as prof. in the Univ. of Paris, and afterward at Orleans, then in highest repute as a legal school. Returning to Scotland, he was made successively official-gen. of the diocese of Glasgow (1471–2), rector of the univ. 1474, and official of Lothian 1478, 'then probably the second judicial office in the kingdom.' He was made bp. of Ross 1481; bp. of Aberdeen 1483. Before the death of James III. he was several times engaged in foreign embassies, and was chancellor of the kingdom. Under James IV. he seems to have been keeper of the Privy Seal from 1492 till his death. He was faithful in the care of his diocese, reforming the clergy, the service, and the ritual. It is believed to have been chiefly through his influence that the first printing-press was established in Scotland. He procured (1494) from the pope (Alexander VI.) a bull for erecting a univ. in Aberdeen; and the college, founded 1500, was dedicated to St. Mary—a name afterward changed to King's College. E. added to his cathedral church at Aberdeen, provided its great bells, and, at his own expense, built a stone bridge over the Dee. The fatal battle of Flodden, 1513, Sep. 9, broke his spirit and he was never afterward seen to smile. He was buried before the high altar of the chapel of the college which he founded. E. was a man of great vigor of mind and nobleness of nature. His *Breviarium Aberdonense*, printed 1509–10, was reprinted (2 vols. quarto) London, 1853.

EL ROSARIO, ēl-rō-sā'rē-ō: small town of the Mexican Confederation, state of Cinaloa; 55 m. e.n.e. of Mazatlan. It is important chiefly as a commercial entrepôt between Mazatlan and the interior. Pop. 5,000.

ELSASS, and ELSASS-LOTHRINGEN (same as **ALSACE** and **ALSACE-LORRAINE**): see **ALSACE-LORRAINE**.

ELSBERG—ELSINORE.

ELSBERG, *ěls'berg*, LOUIS, M.D.: 1736, Apr. 2—1885, Feb. 19; b. Iserlohn, Prussia: physician and author. He came to the United States with his parents 1849, was educated in the public schools of Philadelphia, graduated at Jefferson Medical College 1857, and became resident physician at Mount Sinai Hospital, New York. Shortly afterward he went to Europe for further and special studies, and on his return settled in New York and made a specialty of throat diseases. He introduced medical laryngoscopy into the United States, established the first public clinic for his specialty, took the gold medal prize of the American Med. Assoc. with an essay on *Laryngoscopical Surgery, illustrated in the Treatment of Morbid Growths within the Larynx*, 1865, published the *Archives of Laryngology* (a quarterly), and *A Complete Manual of Throat Diseases*, 1880-84, and wrote a number of essays on scientific, musical, and literary subjects.

ELSE, ad. *ěls* [AS. *elles*, otherwise: OF. *el*; Gr. *allos*; L. *aliūs*, other: Gael. *eile*, another]: other; different; besides: CONJ. otherwise; in the other case: N. other person or thing. ELSEWHERE, ad. *ěls'hwär*, in any other place; in some other place; in other places.

ELSHOLTZIA, n. *ěl-shöltz'i-a* [named after J. S. *Elsholtz*, a Prussian botanist]: in bot., the typical genus of *Elsholtziæ*, a family of *Lamiaceæ*, tribe *Mentheæ*.

EL SINORE. *ěl-si-nör'* (Dan. *Helsingör*): town and seaport of Denmark, on the island of Seeland, on the w. shore of the Sound, and at its narrowest part, $3\frac{1}{2}$ m. w.s.w. of the town of Helsingborg in Sweden, and 24 m. n. of Copenhagen; lat. $53^{\circ} 2'$ n., long. $12^{\circ} 36'$ e. The town, in recent times considerably improved, is spacious, and consists of one long principal street, with several lateral branches. The cathedral, containing some fine tombs, many very old, is one of the most interesting edifices. At a short distance e. of E. are the castle and the fortress of Kronborg, the former a white stone building in Gothic style, the latter, a stronghold mounted with guns that command the Sound in all directions. To the n.w. of E., and in its immediate vicinity, is the royal château of Marienlist, the pleasure-grounds of which, occupying the crest of a hill, are open to the public. From the grounds of Marienlist, magnificent views are had of the Sound, of Helsingborg, and of the plains of Sweden. The harbor of E., formed by a wooden pier, is accessible to ships of light draught. E. has a brisk foreign trade, and has manufactures of straw-hats, arms, sugar, brandy, etc., also cotton-printing and fisheries. The Sound Dues (q.v.) were collected here. Pop. (1880) 8,978; (1890) 11,082.

Saxo Grammaticus, famous writer of the 12th c., was born here. Here Shakespeare laid the scene of his *Hamlet*, a perversion of history on the part of the great dramatist, as Jutland, not Seeland, was Hamlet's country. The vaults under the castle of Kronborg were supposed to be the residence of Holger Danske, the mythic hero of Denmark, who never appeared above ground save when the country was in danger, and was then supposed to march at the head of the

ELSSLER—ELUCIDATE.

Danish armies. In severe winters the Sound is frozen over at E., so that one can walk over the ice from Denmark to Sweden.

ELSSLER, *ĕls'lér*, FANNY. 1810, June 23—1884, Nov.; b. Vienna: celebrated dancer. She was educated at Naples for the ballet, with her eldest sister Theresa. The first success of the sisters was at Berlin, where they appeared 1830. The reputation acquired by Fanny in Berlin preceded her to France, America, England, and St Petersburg, where her beauty, amiability, and mastery in her art, charmed all classes of society. In 1841, the two sisters went to America, where they excited unwonted enthusiasm. After Fanny had earned laurels in St. Petersburg, she returned, 1851, to Vienna, to take a final leave of the stage. She retired first to Hamburg, and then, 1854, to Vienna, where she died. **THERESA E.** (1808–78), was less graceful in her motions than her sister, but exhibited great strength, boldness, and agility. In 1850 she became the wife of Prince Adalbert of Prussia, who died 1873.

ELSTER, *ĕl'stér*, BLACK: river of Germany, rising in the kingdom of Saxony, within two m. of Elstra. It flows n.w., enters Prussia, and joins the Elbe eight m. s.e., of Wittenberg. Length, 130 miles.

ELSTER, WHITE: river of Germany, rising at the foot of the Elster Mountains, on the n.w. boundary of Bohemia. It flows in a northerly direction, and falls into the Saale three m. s. of the town of Halle, in Prussia. Its chief affluent is the Pleisse from the right. Total length, 165 miles.

ELSTRACKE, REGINALD or RENOLD: English engraver; lived abt. 1620. He worked chiefly for the booksellers, and his plates, executed with the graver, without etching, are almost entirely portraits. Prints from his plates are much sought after, not only from their scarcity, and as illustrating English history, but as works of art, in which much character is expressed in a firm and forcible manner. When he did not sign his plates with his name, he marked them with his initials, R. E.

ELTON, *ĕl-tōn'*: famous salt lake of Russia, in the govt. of Saratov, 170 m. s.s.e. from the town of Saratov. The lat. of its centre is $48^{\circ} 56'$ n., and the long. $46^{\circ} 40'$ e. Its longest diameter is 11 m., its shortest about 9 m.: superficial extent of 45,500 English acres. At no place is it more than about 15 inches in depth. It is of oval form, and can be easily reached from the s., but the n. banks rise so rapidly that access to it from that quarter is difficult. In the hottest season, so wonderful is the illusion produced by the crystallized salt, that the lake seems covered with snow and ice. E. yields about 100,000 tons of salt annually, in the collection of which about 10,000 persons are employed.

ELUCIDATE, v. *ĕ-lō'si-dāt* [mid. L. *elucidātus*, made clear—from L. *e*, out of; *lucidus*, bright, clear: F. *élucider*; to make clear; to throw light upon; to explain. **ELUCIDATING**, imp. **ELUCIDATED**, pp. **ELUCIDATOR**, n. one who. **ELUCIDATION**, n. *-dā'shūn* [F.—L.]: the act of

ELUDE—ELVAS.

throwing light upon anything obscure; illustration; explanation. ELUCIDATIVE, a. *-tīv*, or ELUCIDATORY, a. *-tēr-ī*, explanatory.

ELUDE, v. *ě-lōd'* [F. *éluder*—from L. *eludērē*, to mock, to deceive—from *e*, out of; *lūdō*, I play: It. *eludere*]: to escape; to shun; to evade; to avoid by artifice; to escape being seen. ELUDING, imp. ELUED, pp. ELUDIBLE, a. *-dī-bl*, capable of being eluded. ELUSION, n. *-lōzhūn* [L. *elūsīs*, mocked, deceived]: escape by artifice; evasion. ELUSIVE, a. *-zīv*, deceptive; using arts to escape. ELUSIVELY, ad. *-lī*. ELUSORY, a. *-zér-ī*, tending to elude or deceive; deceitful; evasive.—SYN. of ‘elude’: to escape; avoid; eschew; flee; mock; baffle.

ELUL, n. *ě'lul*: sixth month of the Jewish ecclesiastical, and the twelfth of the Jewish civil, year. It begins with the new moon of September.

ELUTRIATE, v. *ě-lō'trī-āt* [L. *elūtriātus*, washed out, decanted—from *e*, out of; *lūtūs*, washed]: to purify by decanting or straining off; to cleanse by washing. ELUTRATING, imp. ELUTRIATED, pp. ELUTRATION. n. *-ā'shūn*, process of separating, by means of water, the finer particles of earths and pigments from the heavier and metallic portions. The apparatus generally used is a large vat, in which grinding wheels revolve, and the substance to be reduced to powder being placed in the vat with water, the wheels in revolving not only pulverize the material, but from their motion being communicated to the water, the latter is enabled to retain in mechanical suspension the finer particles of the clay, etc. By allowing a stream of water to flow in and out of the vat, the finer particles can be constantly floated away, and the liquid being run into settling vats, the fine powder settles to the bottom, when the water can be run off from the surface. This process is usual in the manufacture of the materials used in pottery, and in the preparation of pigments.

ELUXATION, n. *ě-lüks-ā'shūn*: dislocation or pulling out of joint of a bone.

ELVAN, a. *ělv'ān* [see ELF]: pertaining to elves. ELVAN COURSES, or ELVANS, veins of a granular crystalline mixture of felspar and quartz, probably proceeding from a granite mass, which are found in granite rocks and fossiliferous slates in Cornwall, Devon, and the s. of Ireland.

ELVAS, *ěl-vás*: episcopal city and fortress of Portugal, in a very fruitful district on the e. frontier of the province of Alemtejo, 10 m. w. of Badajoz, 40 m. n.e. of Evora. It is the strongest fortress in Portugal, and one of the strongest in Europe. It is built upon a precipitous hill; is surrounded by walls, and by a glacis and covered-way. Besides these, E. has defenses in two formidable forts, Fort Sta. Lucia, and Fort Lippe, the former to the s., and the latter—almost entirely shell-proof—to the n. of the city. E. is an old town; many of its houses are badly built. Its most striking architectural feature is an enormous aqueduct, which conveys water to it from a distance of three miles. This aque-

ELVER—ELY.

duct consists of four tiers of arches built upon one another, and rising to the height of about 250 ft. The chief manufactures of E. are arms and jewellery. Here are extensive store-houses filled with British manufactures, and the inhabitants, by illegally selling these goods within the Spanish frontier, gain large profits. Pop. 10,471.

E. has undergone many sieges, but has never been taken. The Spaniards besieged it 1385, and again 1659, when a famous battle took place called the Lines of Elvas, in which the Portuguese, though greatly inferior in numbers, drove the Spaniards from their lines in front of the town. E. was raised to the rank of a city 1513 by D. Manoel, king of Portugal.

ELVER, n. *ĕlv'ér* [the young eels in their passage up the Thames are called *eel-fare*, of which it is a probable corruption]: small eel; specifically, a young conger or sea-eel. *Note.*—*eel-fare* signifies literally *eel-passage*, from AS. *faran*, to go.

ELVES, n. *ĕlvz*: plu. of **ELF**, which see: see also **FAIRIES**. **ELV'ISH**, the same as **ELFISH**.

ELY, *ĕ'lī* (so called from a Saxon word, *elig*, an eel, or *helig*, a willow): cathedral town—rather than a city—on an eminence in that part of the fen-country of Cambridgeshire, England, called the *Isle of Ely*. The Eastern Counties and Great Northern railways have each stations, the former outside, the latter in the town. Pop. (1881) 8,172; (1891) 8,017.

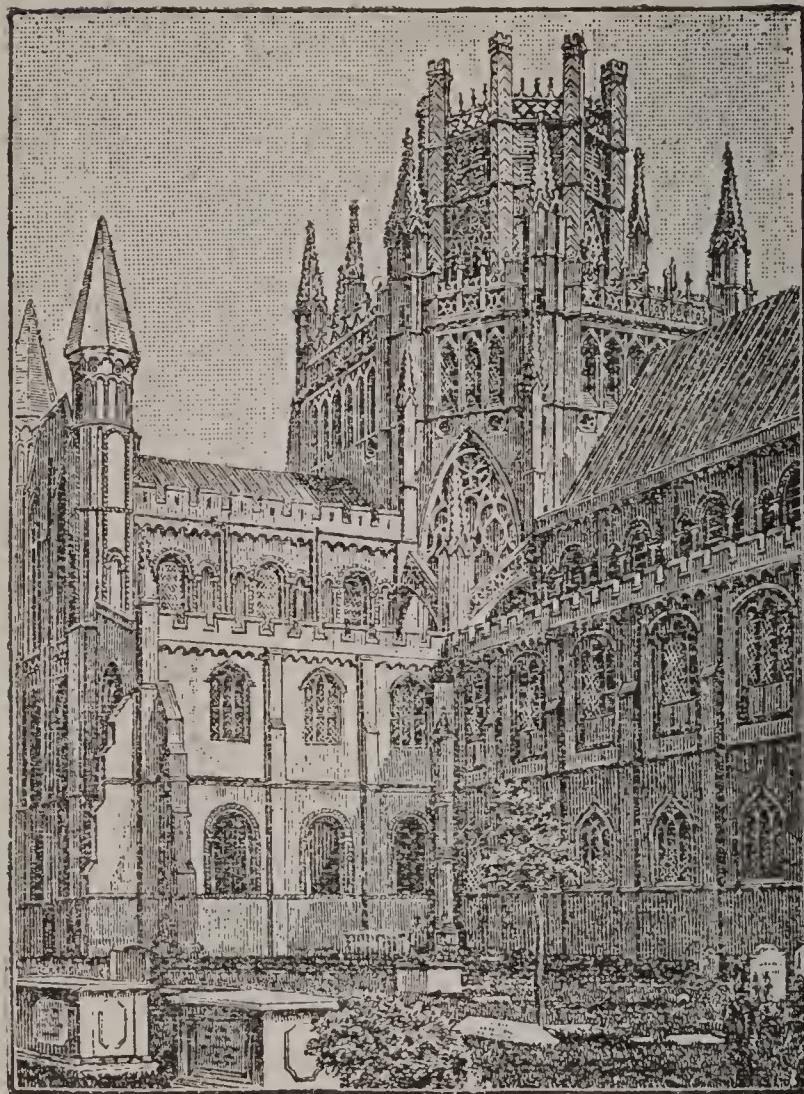
Ely Cathedral.—About 673, Etheldreda, daughter of the king of East Anglia, and wife of Oswy, King of Northumberland, founded a monastery here, and took on herself the government of it. 200 years afterward (870), the Danes ravaged the Isle, and destroyed the monastery, which was rebuilt 970 by St. Ethelwold, bp. of Winchester; and this continued till 1081, when a new church was begun, which was converted into a cathedral, and the abbey erected into a see 1109. The possessions of the abbey were divided between the bishop and the community. The cathedral contains some beautiful specimens of architecture, especially of Early Norman. Its exterior dimensions are 535 ft. from w. to e. The great cross or main transept is 190 ft. The turrets of the w. tower are 215 ft. high, and the lantern over the central tower 170 ft. The w. front was built by Geoffrey Ridell, third bishop (d. 1189), and is of Norman work. About 200 years after his time, an addition of 64 ft. was made to the tower, and over that a spire. This great superincumbent weight crushed the n.w. transept, and the s.w. one, which still remains, was considerably weakened. In front there is a w. portico or galilee (q. v.), of Early Gothic, said to be the work of Bp. Eustachius. The nave is of Norman work, completed about 1174. The columns are alternately round and octagonal. The roof was, 1861, beautifully painted. The transepts, the most ancient parts of the church, were built in the reign of Henry I. They had originally a middle and two side aisles, but the latter are, in the s. transept, walled up, and the space used as a vestry and library. Originally there stood a square tower in the centre of the

building, opening into the nave and transepts; but this gave way 1322, and fell eastward, crushing three arches of the choir. The repair of this dilapidation was undertaken by the sacrist of that time, Alan de Walsingham. The design was original, an octagon tower with four longer and four shorter sides, surmounted by a lantern. The upper part of this, of timber, has recently been rebuilt.

The choir contains some rich varieties of decorated Gothic, and the fine shafts of Purbeck marble combine beautifully with the white stone work. The whole has lately been restored and beautified. Originally, it was much shorter eastward, and protruded into the nave, but in 1235 the semicircular end of the old church was taken down, and six arches added by Hugh de Northwold. At the dedication and removal of the relics, Henry III. and his court were present. The e. end is eminently beautiful: it consists of two tiers of high lancet-shaped windows. Perhaps the most interesting and beautiful part of the building is the Lady Chapel—an incomparable work, irreparably spoiled by the barbarism of Puritan times. It was begun 1321, and finished 1349, simultaneously with the rebuilding of the central tower and ruined choir, a fact highly illustrative of the taste and munificence of the times. It has a stone roof, like King's College Chapel in Cambridge, which it is supposed to have suggested, and the walls were once decorated from top to bottom with countless niches and images of saints and martyrs, not one of which remains undefaced. Its length is 100 ft.; width, 46; height, 60. Bp. Alcock's Chapel, in which he lies buried, is at the e. end of the n. aisle—an overloaded specimen of the richest florid Gothic. Bp. West's Chapel, at the e. end of the s. aisle, is a more pleasing example of the same style.

Among celebrated names connected with E. are Abbot Thurstan, who defended the Isle against William the Conqueror for seven years; Longchamp, chancellor and regent under Richard I.; Chancellor Morton, Simon Patrick, and Bp. Andrews. The bishops of E., like the bishops of Durham, formerly possessed a palatine jurisdiction, and appointed their own chief-justice, etc.; but this privilege was taken from them by the 6th and 7th Will. IV. The bp. of E. is visitor to St. Peter's, St. John's, and Jesus Colleges, Cambridge, of which last he also appoints the master. There is a grammar-school attached to the Cathedral, founded by Henry VIII. There are some interesting remains of the old conventional buildings in the neighborhood of the Cathedral.

ELY, ISLE OF: south part of the Bedford Level, or the part of Cambridgeshire n. of the Ouse. It includes above a half of this county, is 24 m. long from n. to s., with an average breadth of 14 m., and contains four hundreds. It is a monotonous, marshy, or fenny plain, formerly covered with water, and abounding in aquatic birds and plants. It consists chiefly of black earth and turf, and, where well drained by innumerable artificial canals and ditches, it produces fine crops of hemp, flax, wheat, oats, and cole



Ely Cathedral—Octagon.



Emarginate.—Leaf of *Buxus sempervirens* and Flower of *Primula sinensis*, showing (*a, a*) Emarginations or notches.

ELY.

seed. Over it are interspersed small eminences, generally crowned with villages and towns, as Ely City, March, Thorney, Whittlesea, and Wisbeach. Pop. about 63,000.

ELY, EZRA STILES, D.D: Presbyterian clergyman; 1786, June 13—1861, June 18; b. Lebanon, Conn. He graduated at Yale Coll. 1803, studied theology and was ordained pastor of the Colchester (Conn.) Congl. Church 1806. Later he was chaplain of the New York Hospital. In 1834, he attempted to establish a theol. seminary in Mo., but was obliged to abandon the project on account of reverses of fortune. He was one of the founders of Jefferson Medical Coll., of which he was also a trustee. During his life he gave to Jefferson Medical Coll. and other institutions an aggregate of \$50,000. Dr. E. was pastor of the Pine St. and Northern Liberties Presb. Churches in Philadelphia. He published *Science of the Human Mind* (1819); *Contrast Between Calvinism and Hopkinsianism* (1811); *Endless Punishment* (1835); and *A Collateral Bible, or Key to the Holy Scriptures* (1826-28).

ELY, RICHARD THEODORE, PH.D., LL.D.: 1854, April 13———; political economist; b. Ripley, N. Y. He graduated at Columbia Coll. 1876, winning the graduate fellowship of letters, which enabled him to study for 3 years at Heidelberg Univ., Germany, where he received the degree PH.D 1879. In 1885-92 he was assoc. prof. of political economy in Johns Hopkins Univ.; in the latter year took the chair of political economy in the Univ. of Wis. He was a frequent contributor to periodical literature from the beginning of his literary career, and on politico economical subjects has been recognized as an authority. He published *French and German Socialism in Modern Times* (1883); *The Past and Present of Political Economy* (1884), *The Labor Movement in America* (1886); *Co-operation in America* (1887); *Outlines of Economics* (1893); *Socialism and Social Reform* (1894). On the publication of the latter work the state supt. of public education charged E. with teaching pernicious theories of socialism; but a committee exonerated him, and the board of regents approved the decision.

ELY, WILLIAM G.: 1835———; military officer. He served as a private at the beginning of the civil war, and later was lieut.col. of the 6th infantry and afterward col. of the 18th. regt. In 1863, June 13, while in charge of the 2d brigade, he was taken prisoner and confined in Libby prison, Richmond, Va., till the following Feb., when he escaped, but was recaptured. He was paroled, however, a few weeks later, and sent North, and shortly afterward exchanged. He rejoined his regt. 1864, May 17, and was in command of it at the battle of Piedmont, June 4. He was brevetted brig.gen. 1864, Sep.

ELYMAIS—ELYTRON.

ELYMAIS, ēl-ī-mā'īs: ancient province on the Persian Gulf. The name is sometimes applied to the whole of Elam, though E. was probably only a district of Elam.

EL'YMUS: see LIME GRASS.

ELYNA, n. ē-lī'nā [Gr. eluō, I roll round]: in bot., typical genus of *Elyneæ*, a tribe of *Cyperaceæ*.

ELYRIA, ē-līr'ī-a: town, cap. of Lorain co., O.; at junction of e. and n. branches of Black river; on the Lake Shore and Michigan Southern railroad at the junction of the Sandusky and Norwalk divisions; 7 m. s. of Lake Erie, 8 m. n.n.e. of Oberlin, 25 m. w.s.w. of Cleveland. The chief industries are the manufactures of cheese, grindstones, tobacco, confectionery, and screws, power for which is supplied by the river, which has a fall of 40 ft. here. E. has a national bank (cap. \$150,000), a state bank (cap. \$200,000), 8 churches, a public library, law library, several graded schools, and 3 newspapers, and exports sandstone. Pop. (1870) 3,038; (1880) 4,777; (1890) 5,611.

ELYRIA, n. ē-līz'ī-a [L. *elysius*, pertaining to Elysium, the place of bliss]: a genus of mollusks, the type of *Elysiadææ*, a family of nudibranchiate gasteropoda, shell-less and snail like, with no distinct mantle or breathing organ, a single series of lingual teeth, and the sexes united. It contains 7 to 11 genera, as variously constituted.

ELYSIAN, a. ē-līzh'ī-ān [L. *elysiūm*; Gr. *elusīōn*, the abode of the blessed]: pertaining to Elysium; delightful in the highest degree. ELYSIUM, n. ē-līzh'ī-ūm, in *anc. classical myth.*, a place in the infernal (in the sense of *lower*) regions, where the souls of the good dwell after death. In the *Odyssey*, Homer described it as a place where the souls of the departed lived in ease and abundance among innocent pleasures, and enjoying a mild and wholesome air. In the *Iliad*, however, he gives a sombre view of the state of the departed souls. Achilles, though in Elysium, is made to envy the life of the meanest hind on earth. By succeeding poets, the bliss of Elysium is drawn in much more lively colors. Besides the amenity and various delights of the place, diverse employments are found for the inhabitants, according to the ruling passion of each while on earth. Elysium was supposed by some writers to be in mid-air, by others in the sun, by others in the centre of the earth, next Tartarus, by others, in the Islands of the Blest. In modern figurative usage, it denotes any delightful place. ELYSIAN FIELDS, in *anc. classical myth.*, the garden of Paradise, the abodes of happiness in the future life.

ELYTRON, n. ēl'ī-trōn, or EL'YTRUM, n. -trūm, EL'YTRA, n. plu. -trā [Gr. ēlūtron, a covering or sheath]: the hard coriaceous case or sheath which covers the wings of such insects as the beetle; the wing-sheath. ELYT'RIFORM, a. -fawrm [L. *forma*, shape]: in the form of a wing-sheath.

ELZEVIR—EMAILOMBRANT.

ELYTRINE, n. ēl'i-trīn, the substance of the coriaceous wing-sheaths of beetles.

ELZEVIR, n. ēl'zē-vēr: name given to works, chiefly ancient classics, printed and published mostly between 1583–1680, by the family *Elzevir* or *Elzevier*, at the Hague, Amsterdam, Leyden, and Utrecht; the name denotes also a kind of type first used by them. Of this celebrated family of printers, the first, LOUIS E., is said to have been born at Louvain about 1540. He was induced by religious disturbances to leave his native city, and, 1580, he settled as a bookbinder and bookseller in Leyden, where he died about 1617. The first work edited by him bears the title *Drusii Ebraicarum Quæstionum ac Responsionum Libri Duo, videlicet Secundus ac Tertius, in Academia Lugdunensi MDLXXXIII. Veneunt Lugduni Batavorum apud Elseuirium e Regione Scholæ Novæ*. The second, a *Eutropius* by P. Merula, bears date 1592, and was long erroneously believed to be the first from E.'s press. Five of Louis's seven sons continued their father's business. Their names were Matthew, Louis, Aegidius, Jodocus (Joost), and Bonaventura. The last, in conjunction with his nephew Abraham E. (son of Matthew), prepared the smaller editions of the classics, in 12mo and 16mo, still valued for their beauty and correctness. It is mainly on these that their reputation is based. The house of E., in Amsterdam, was established 1638, by Louis, son of Jodocus E. Peter E., grandson of the last mentioned, carried on the bookselling business in Utrecht, and died 1696. For more than a century, however, this family has ceased to have any connection with book-printing. It is believed that 1,213 works in all proceeded from the E. presses. Among the most beautiful are the editions of Pliny, Virgil, Livy, Tacitus, and Cæsar; and, though for Greek and Hebrew texts the house of E. was surpassed by that of Stephens (q.v.), their Latin classics are unrivalled both for beauty and for correctness. It is said that the Elzevirs generally employed women to correct the press, under the conviction that they would be less likely than men, on their own responsibility, to introduce alterations into the text. Compare Adry, *Notice sur les Imprimeurs de la Famille des Elzevier* (1806); Pieter, *Annales de l'Imprimerie Elsévirienne* (1852); Willems, *Les Elzevier* (Brussels, 1880).

EM, ēm [F. *en*: L. *in*: Gr. *en*]: a prefix; a form of *en*, which becomes *em* before *o*, *p*, or *m*: AS. prefix *em* signifies to make, to surround: Gr. prefix *em* signifies *in* or *on*; *em*, for L. *im*, signifies *in*, *on*, or *into*.

EMACIATE, v. ē-mā'shī-āt [mid. L. *emaciātus*, made lean—from L. *e*, out of; *maciārē*, to make lean or thin; *maciās*, leanness]: to become lean; to deprive of flesh; to lose flesh gradually; to pine or waste away. EMACIATING, imp. EMACIATED, pp. EMACIATION, n. -ā'shūn, a making lean; a becoming lean by a gradual waste of flesh; the state of being reduced to leanness: see CONSUMPTION: TABES DORSALIS.

EMAILOMBRANT, n. ē-māl'ōm-brant [F. *email*, enamel,

EMANATE—EMANCIPATION.

and *ombrer*, to shade], process which consists in flooding transparent colored glass over designs stamped on earthenware or porcelain. A plane surface is thus produced, in which the cavities of the design appear as shadows of various depths.

EMANATE, v. *ěm'ā-nāt* [L. *emānātus*, flowed out—from *e*, out of; *mānō*, I flow: It. *emanare*: F. *émaner*]: to issue or flow from something, as a source; to arise or spring from. **EMANATING**, imp. **EMANATED**, pp. **EMANATION**, n. *-nā shūn* [F.—L.]: that which issues or proceeds from any object as a source; a flowing from; an efflux. **EMANATIVE**, a. *-tīv*, issuing from another. **EMANATIVELY**, ad. *-lī*. **EMANATORY**, a. *-nā tēr-ī*, having the nature of an emanation.—**SYN.** of ‘emanate’: to spring; proceed; advance; flow; arise; issue.

EMANATION, in Theology and Philosophy: an ancient doctrine, which considered all things as emanating or flowing from a Supreme Principle, or the Original Being. According to this doctrine, the origin of things is only an overflowing of the divine fulness—an outstreaming of the light from the necessity of its nature, and not through any free action on the part of God. What is thus given off as a copy from original perfection, departs more and more from its source, and gradually degenerates, which was thought to account for the origin of evil. This doctrine came from the East, and pervades the Indian mythology, the system of Zoroaster, and the Neo-Platonic philosophy of Alexandria. In Christian theology, the idea of emanation has been applied to explain the relation among the persons of the Trinity.

EMANCHÉ: see **MANCH**.

EMANCIPATE, v. *ě-mān'sī-pāt* [L. *emancipātus*, declared free and independent—from *e*, out of, from; *mancipium*, the legal sale of a thing, a slave—from *mānus*, the hand; *cāpiō*, I take]: to set free from bondage or slavery; to restore to liberty; to free from any controlling influence; to manumit. **EMANCIPATING**, imp. **EMANCIPATED**, pp. set free from bondage or servitude; liberated. **EMANCIPATION**, n. *-pā shūn* [F.—L.]: deliverance from slavery (see **SLAVERY**); deliverance from bondage or controlling influence; the act of setting free from civil disabilities. **EMANCIPATIONIST**, n., or **EMANCIPATOR**, n. *-tēr*, an advocate for the abolition of slavery; one who liberates from bondage or slavery. **EMANCIPIST**, n. *-pīst*, in *Australia*, a convict who has been set free, or who has regained his liberty.—**SYN.** of ‘emancipation’: deliverance; liberation, release; freedom.

EMANCIPATION, in the Roman Law: act by which the *Patria Potestas* (q.v.), or paternal authority, was dissolved in the lifetime of the father. It took place in the form of a sale (*mancipatio*) by the father of the son to a third party, who manumitted him. The Twelve Tables required that this ceremony should be gone through three times, and it was only after the third sale that the son became *sui juris* under his own law. In general, the son was at last released

EMANCIPATION—EMARGINULA.

to the father, who manumitted him, and thus acquired the rights of a patron (q.v.), which would otherwise have belonged to the alien purchaser who finally manumitted him. In the case of daughters and grandchildren, one sale was sufficient. If the child died intestate, or if he required a tutor or curator, the father's rights as patron came into play; but if the father died intestate, the son took nothing, because he was out of his family. But this rigor of the old law was modified by the prætor's edict, which placed all the children on the same footing. In the law of Scotland, emancipation is called Forisfamiliation (q.v.). The only case in which the term is employed in English law is with reference to poor-law settlements: see SETTLEMENT: POOR AND POOR-LAWS.

EMANCIPATION, ROMAN CATHOLIC: see ROMAN CATHOLIC EMANCIPATION.

EMANUEL I., ēm-ān'ū-ēl, King of Portugal, styled THE GREAT, sometimes THE FORTUNATE: 1469, May 3—1521, Dec. 13 (reigned 1495–1521). Before his accession to the throne at the death of John III., he bore the title of Duke of Beja. On his accession, he prepared the code of laws which bears his name, and rendered himself remarkable by his zealous activity in the cause of education, by his active piety, and by his predilection for the society of artists and scholars. Through his exertions, Portugal became the first naval power of Europe, and the centre of the commerce of the world. He dispatched Vasco da Gama to sail round the Cape of Good Hope, and discover the passage to India. Cabral was commissioned by him to prosecute further the discoveries of Vasco da Gama, and Corte Real to sail along the coasts of N. America. The expeditions under Albuquerque put E. in possession of the s. coast of Africa and of the Indian Archipelago. Not satisfied with this, he opened a communication with Persia, Ethiopia, and, 1517, with China. At his death Portugal was in possession of a large fleet, strong fortresses, well-furnished arsenals, a war-like army, a flourishing trade and commerce, and extensive colonies. His reign has been termed the golden age of Portugal. E. was thrice married: first to Isabella, daughter of Ferdinand; afterward to Mary of Castile, her sister (by whom he had two children, John and Isabella, the former of whom succeeded him on the throne); and thirdly, to Eleanore of Austria, sister of Charles V.

EMARGINATE, a. ē-mār'jī-nāt, or EMARGINATED [L. *emarginatus*, deprived of its edge—from *e*, out of; *margo*, the extremity or margin]: having the margin broken by an obtuse notch or the segment of a circle; in bot., slightly notched at the summit, as if a piece had been cut out: see LEAVES.

EMARGINULA, n. ē-mār-jīn'ū-la [dim. of L. *emarginatus*, notched]: genus of mollusks having shells with a notch upon the anterior margin. Forty recent species are known, and 40 fossil. The former extend in space from Britain to Australia, the latter in time from the Trias till now.

EMASCULATE—EMBALM.

EMASCULATE, v. ē-măs'kū-lāt [mid. L. *emasculātus*, castrated—from L. *e*, out of; *mascūlūs*, a male: It. *maseolo*, a male]: to geld or castrate; to weaken; to render effeminate. EMAS'CULATING, imp. EMAS'CULATED, pp. EMAS'CULATION, n. -lā'shūn [F.—L.]: the act of depriving of virility; unmanly weakness.

EMBA, ēm'bā: river of Turkistan, Kirghiz territory. It rises at the w. base of the Muehajar or Mongojar Mountains, and flowing s.w. enters the Caspian Sea after a course of about 300 miles.

EMBALE, v. ēm-bāl' [em, to make, and *bale*: F. *emballe*, to paek up]: in *OE.*, to make up into a bundle; to inclose. EMBAL'ING, imp. EMBALED', pp. -bāld'.

EMBALM, v. ēm-bām' [F. *embaumer*, to embalm or perfume—from *em*, in; *baume*, balsam—from L. *balsānum*]: to fill the internal parts of a dead body with aromatics and drugs in order to preserve it from deeay; to preserve and treasure with great eare; to preserve with affection, as, to embalm in one's memory. EMBALM'ING, imp.: N. a process by whieh a dead body is preserved from putrefaction and deeay. EMBALMED', pp. -bāmd'. EMBALM'ER, n. -ér, one who.—The art of embalming was invented by the Egyptians, whose prepared bodies are known by the name of mummies, and are called in the hieroglyphs *sahu*, and



Egyptian Mummy.

by St. Augustine *gabbaroe*. This art seems to have derived its origin from the notion, that the preservation of the body was neecessary for the return of the soul to the human form after it had completed its eyele of existence of three or ten thousand years. Physieal and sanitary reasons also may have induced the aneient Egyptians; and the legend of Osiris, whose body, destroyed by Typhon, was found by Isis, and embalmed by his son Anubis, gave a religious sanetion to the rite, all deeeased persons being supposed to be embalmed after the model of Osiris in the *abuton* of Philæ. The art appears as old as b.c. 4,000 at least, the bodies of Cheops, Mycerinus, and others of the age of the 4th dynasty having been embalmed. One of the earliest recorded embalmments on record is that of the patriarch Jacob; and the body of Joseph was thus prepared, and transported out of Egypt. The process has been described by Herodotus and Diodorus; but their aceounts can refer only to their own age, and are only partially eonfirmed by an examination of the mummies. The following seems to have been the usual rule observed after death. The relations of the deceased went through the eity chanting a wail for the dead. The eorpse of a male was a* once

EMBALM.

committed into the charge of the embalmers; if a female, it was retained at home till decomposition had begun. The *paraschistes*, or flank-inciser of the district, a person of low class, whose establishment was in the cemeteries or suburbs, conveyed the corpse home. A scribe marked with a reed-pen a line on the left side beneath the ribs, down which line the paraschistes made a deep incision with a rude knife or Ethiopian stone, probably flint. He was then pelted by those around with stones, and pursued with curses. Another kind of embalmer, the *taricheutes*, or preparer, then proceeded to remove the entrails and lungs, with the exception of the heart and kidneys. The brain was extracted by another taricheutes, by a crooked instrument, through the nose. All this having been effected, the body was ready for the salts and spices necessary for its preservation, and the future operations depended upon the sum to be expended on the task. When Herodotus visited Egypt, three methods prevailed: the first, accessible only to the wealthy, consisted in passing peculiar drugs through the nostrils into the cavities of the skull, rinsing the belly in palm-wine, and filling it with resins, cassia, and other substances, and stitching up the incision in the left flank. The mummy was then steeped in natron for 70 days, and wrapped up in linen, cemented by gums, and set upright in a wooden coffin against the walls of the house or tomb. This process cost a silver talent, which, considering the relative value of ancient money at one-third of that at present, would amount to somewhat more than \$3,500. The second process consisted in removing the brain, as before, but only injecting the viscera, with *kedrion*, or cedar oil, and soaking the corpse in a solution of natron for 70 days, which brought away or destroyed the viscera and soft portions, leaving only the skin and bones. The expense was a *mina*, relatively worth about \$1,180. The third process, in use for the poorer classes, washed the corpse in myrrh, and salted it for 70 days. The expense was small, not mentioned. When thus prepared, the bodies were ready for sepulture, but were often kept before burial some time—often at home—and even produced at festive entertainments, to recall to the guests the transient lot of humanity. When buried, they were sent to the *cholchytæ*, a higher class than the *taricheuteæ*, who had charge of the tombs, the mummies, and the masses for the dead. All classes were embalmed, even malefactors; and those who were drowned in the Nile or killed by crocodiles received an embalming from the city nearest to which the accident occurred. As the art, however, was practiced for many centuries, it may be easily conceived that mummies were preserved by very different means, and quite distinct from those described by classical authors, some having been found merely dried in the sand; others salted by natron, or boiled in resins and bitumen, with or without the flank incision, having the brains removed through the eyes or base of the cranium, with the viscera returned into the body, placed upon it, or deposited in jars in shapes of the genii of the dead, the skin partially gilded, the flank incision

EMBALM.

covered with a tin plate, the fingers cased in silver, the eyes removed, and replaced. The mummies are generally wrapped in linen bandages, and placed in costly coffins; see *SARCOPHAGUS*. The sacred animals were also mummied, but by simpler processes than men. The ancient mummies were used in the 15th and 16th c. of the Christian era for drugs and other medical purposes, and for nostrums against diseases; and a peculiar brown color, used as the background of pictures, was obtained from the bitumen. The Ethiopians used similar means to preserve the dead, and the success of embalming may be judged from the numerous mummies in the different museums of Europe. Other less successful means were used by nations of antiquity to embalm. The Persians employed wax; the Assyrians, honey; the Jews embalmed their monarchs with spices, with which the body of our Lord was also anointed; Alexander the Great was preserved in wax and honey, and some Roman bodies have been found thus embalmed. The Guanches, or ancient inhabitants of the Canary Isles, used an elaborate process like the Egyptian; and desiccated bodies, preserved by atmospheric or other circumstances for centuries, have been found in France, Sicily, England, and America, especially in Central America and Peru. The art of embalming was probably never lost in Europe; and De Bils, Ruysch, Swammerdam, and Claderus boast of great success in the art. There was a celebrated cabinet of M. De Rasière 1727, containing prepared bodies; and the mode of embalming princes and others, by prepared balms and other substances, is detailed by Penicher, consisting in the removal and separate embalming of the heart and viscera, and removing the brain, and introducing the preparations by incisions all over the body. Dr. Hunter injected essential oils through the principal arteries into the body. Boudet, during the French Empire, embalmed the bodies of the senators with camphor, balsam of Peru, Jews' pitch, tan and salt; but the discovery of Chaussier of the preservative power of corrosive sublimate, by which animal matter becomes rigid, hard, and grayish, introduced a new means of embalming by Beclard and Larrey; but owing to desiccation, the features do not retain their shape. The discovery of the preservative power of a mixture of equal parts of acetate and chloride of alumina, or of sulphate of alumina, by Gannal, 1834, and of that of arsenic by Tranchini, and of pyroxilic spirits by Babington and Rees, 1839, and of the antiseptic nature of chloride of zinc, have led to the application of these salts to the embalming or preparation of bodies required to be preserved for a limited time; but there is no reason to believe that bodies so preserved will last so long as Egyptian mummies. See Pettigrew, *History of Mummies* (4to. Lond. 1834); Gannal, *Traité d'Embaumement* (8vo, Paris 1838), translated by Harlan (8vo, Philadelph. 1840; Magnus, *Das Einbalsamiren der Leichen* (8vo, Braunsch, 1839).

EMBANK.

EMBANK, v. *čm-băngk'* [*cm*, in, and *bank*]: to inclose or protect by a raised mass of stones or earth; to defend or protect by a mound or dike. EMBANK'ING, imp. EMBANKED, pp. *-băngkt'*. EMBANK'MENT, n. an inclosure by a mound of earth or stone. Embankments, in *engineering*, are masses of earth, rock, or other materials artificially formed, and rising above the natural surface of the ground. They are formed chiefly (1) to bear railways, common roads, canals, etc., over depressions of the country; or (2) for hydraulic purposes, such as the formation of reservoirs for storing water; or as defenses against the overflowing of rivers, the encroachments of the sea, of lakes, etc.

In the formation of canals, railways, and other roads, embankment and *excavation* go hand in hand, and, under the name of EARTHWORK, form a vast branch of industry.

In planning such works engineers follow, as much as possible, the principle of making the cuttings or excavations and the embankments balance; i.e., of making the earth, etc., taken from the cuttings suffice for the formation of the embankments: see RAILWAYS (*Construction*). In proceeding to the actual construction of a railway embankment, e.g., a beginning is made at the points where the level of the formation meets the surface of the ground; and on each side of these points the cutting is taken out, and the embankment formed by men using pick, shovel, and barrow, so that a roadway is formed for a distance of 50 to 100 yards. When the 'lead,' or the distance between the face of the cutting and the 'tip-ahead,' or end of the embankment, is greater than this, it is no longer economical to use the barrow. To continue the cutting and embankment, several methods may be employed; the most common are, dobbin carts; small wagons run upon light rails at a narrow gauge, and drawn by men or horses; ordinary earth-wagons drawn by horses, and occasionally by a locomotive; and lastly, ballast-wagons or trucks drawn by a locomotive. The cost of earthwork naturally varies greatly with the nature of strata in which the cutting has to be made, the length of the 'lead,' and other circumstances. When rocks have to be cut through, blasting (q.v.) is resorted to. One of the points on which considerable doubt existed, was as to the inclination of the side-slopes of embankments; but it has been found that nearly all kinds of earthwork will stand at an inclination of $1\frac{1}{2}$ horizontal to 1 vertical. When, however, it is necessary to use very wet substances, such as peat-moss or wet clays, or when the embankment is of great height, a flatter slope may be necessary. In many cases, it is advisable to substitute a viaduct (q.v.) for an embankment. All embankments put in as above mentioned subside more or less, the subsidence being much more distinctly perceptible in clay than in gravel. When clay is thrown by the wagon over a considerable tip, the lower half of the embankment will be seen to consist of round bullets of clay of sufficient hardness to resist being squeezed into one mass by the weight of the embankment, until, in the course of time, from the effects of moisture, they become gradually disintegrated, and a settlement or sinking

EMBANK.

of the embankment takes place, sometimes to the extent of a twelfth, or even a tenth of the height. The greatest sinking usually occurs during the first wet weather after the formation of the embankment; but it sometimes goes on, though more and more slowly, for years. In the case of railway embankments, this subsidence is seldom of very great importance. If the permanent rails are laid, the labor and expense of restoring them to the level is not great, and the embankment should always be formed sufficiently wide at the top to allow of filling it up to its proper level without adding to the slopes. It is, however, practicable, though rather hazardous, to widen it at the top afterward by cutting trenches in the slopes.

When the side-slope of the ground on which an embankment is to be formed is very steep, the whole work has a tendency to slip laterally; and to prevent this, trenches or steps are cut in the ground before putting in the embankment. When the material is very wet, it sometimes is impossible to prevent the slopes from bulging out, in which case it is generally sufficient to put in additional stuff until the work stands. Peat-moss is seldom used to form an embankment, but frequently an embankment has to be formed where the ground below is moss to a considerable extent. In this case, many plans have been adopted to form a substantial unyielding work, which, where the moss is deep, and contains much water, is often very troublesome and expensive. Among these, perhaps, in most cases, the best is to continue throwing in earth until no further subsidence takes place. In some cases, piling has been adopted, and in others, a layer of tree-tops and brushwood has been placed on the moss as basis for the embankment. When this is done, it frequently happens that the ground on each side of the embankment opens in great rents, rises to a considerable height, and moves laterally from the embankment.

Embankments, when finished, have their side-slopes usually covered with soil and sown with grass-seeds, this not only improves their appearance, but adds considerably to their stability, preventing rain and wind from doing the damage that might otherwise take place.

In regard to embankments to restrain or prevent the encroachment of water, it is necessary, in addition to forming them of sufficient height and strength, to cover the surface of the slopes in such a way that the action of the water will not affect it. Of course the method adopted must depend entirely on the nature of the case; where, for example, the water only occasionally touches the embankment, as in the case of river-floods, and does not run with great violence along it, good turf pinned to the slopes has been found effectual. Where, however, the slopes are subject to the action of waves or rapid water, more effectual and expensive measures must be adopted, such as stone-pitching, piling, etc. Embankments of this nature are used on a great scale in Holland. see DIKE.

Embankments for damming up water to form ponds or reservoirs, require, in addition to the other conditions to

EMBAR—EMBASSY.

be perfectly water-tight; and for this purpose a 'puddle-wall' of clay is carried from top to bottom in the heart of the structure. The great difficulty lies in preventing the water from finding its way between the bottom of the puddle-wall and the foundation on which it rests, or even through the substances of which that foundation consists; and the wall must often be carried to a great depth below the surface of the ground until an impermeable stratum be found. A knowledge of the geology of the place is here essential to the engineer.

EMBAR, v. *ēm-bār'* [*em*, to make, and *bar*]: in *OE.*, to inclose; to block up; to hinder.

EMBARCATION: another spelling of EMBARKATION: see EMBARK.

EMBARGO, n. *ēm-bār'gō* [Sp. *embargar*, to impede, to restrain; *embargo*, impediment, an embargo]: order by authority to a ship or ships not to leave a harbor or port; an order to a ship not to trade for a limited time. It may apply to vessels and goods, or to specified goods only; it may be general or special; it may apply to the entering only, to the departure only, or to both entering and departure of ships from particular ports. Embargoes are generally connected in some way with a state of war between two countries: V. to order a ship not to leave harbor. EMBAR'GOING, imp. EMBAR'GOED, pp. *-gōd*, hindered from sailing or trading for a time.

EMBARK, v. *ēm-bārk'* [F. *embarquer*, to put on ship-board—from *em*, in or on; *barque*, a boat, which see]: to go on board a ship about to sail; to cause to go on board a ship; to engage in any undertaking; to engage another in any affairs. EMBARK'ING, imp. EMBARKED', pp. *-bārk'*. EMBARKATION, n. *ēm'bār-kā'shiōn*, the act of going or of putting on board a ship for a voyage or journey by sea; that which is embarked—sometimes spelled EMBARCATION [F.—L.].

EMBARRASS, v. *ēm-bār'rās* [F. *embarrasser*, to entangle, to perplex: Sp. *embarazo*, obstruction, perplexity: Port. *embaraçar*, to mix, to embroil—from the root *bar*, used to represent confused sound]: to confuse; to perplex; to entangle; to involve; to abash. EMBAR'RASSING, imp.: ADJ. perplexing; confusing. EMBAR'RASSED, pp. *-bār'rāst*, perplexed; confused. EMBAR'RASSMENT, n. *-mēnt*, perplexity; confusion; distress or perplexity from inability to discharge debts.—SYN. of 'embarrass': to clog; hinder; encumber; impede; obstruct; fetter; retard; prevent; shackle; perplex; entangle; confuse; disconcert; puzzle; distress; abash.

EMBASE, v. *ēm-bās'* [*em*, to make, and *base*]. in *OE.*, to debase; to degrade; to lower. EMBAS'ING, imp. EMBASED', pp. *-bāst'*.

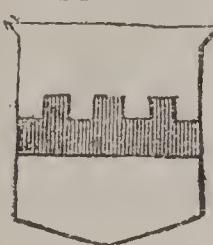
EMBASSY, n. *ēm'bās-sī*, or EM'BASSAGE, n. *-sāj* [mid. L. *ambasciū*, business of another, message committed to another: F. *ambassade*; OF. *embassade*, an embassy, a love-message (see AMBASSADOR)]. a public message to another

EMBATERION—EMBELLISH.

nation; the charge of a public minister to a foreign court; the minister himself, his residence and suite; a solemn message. In a popular sense, all diplomatic missions are spoken of as embassies; but this is not the technical meaning of the term. In its more limited acceptation, embassy is a mission presided over by an ambassador, as distinguished from a mission or legation intrusted to an envoy, or other inferior diplomatic minister. The only difference between the powers and privileges of the ambassador and the envoy is, that the former represents the person of his sovereign, or of the supreme official of his govt., and in this capacity he can demand a private audience of the sovereign to whom he is accredited; while the latter must address himself to the minister for foreign affairs. A residence is provided for the ambassador, and an allowance for house-rent is made to inferior ministers, in addition to their salaries. see **AMBASSADOR**: **ENVY**: **CONSUL**: **MINISTER**, in **Diplomacy**.

EMBATERION, *ĕm-bă-tē'ri-on*: war-song of the Spartans, accompanied by flutes, which they sang marching in time, and rushing on the enemy. The origin of the E. is lost in antiquity.

EMBATTLE, v. *ĕm-bătl'* [em, in or on, and *battle*: comp. a supposed OF. *embastiller*; mid. L. *imbattūlārē*, to fortify]:



Embossed.

to array troops for battle; to indent for ornament or defense, as a wall. **EMBATTLED**, imp. *-bătl'ing* **EMBATTLED**, *-bătl'd*: ADJ. furnished with battlements; in her., embattled or imbattled (called also Crenellé), is one of the partition lines, traced in the form of the battlements of a castle or tower. A bordure embattled is often given as a difference to any member of a family who is,

or has been, a soldier. **EMBATTLEMENT**, n. *-bătl'-mĕnt*, an indented parapet-wall: see **BATTLEMENT**.

EMBAY, v. *ĕm-bā'* [em, in, and *bay*]: to inclose, as a ship in a bay, or between points of land. **EMBAYING**, imp. **EMBAYED**, pp. *-bād'*.

EMBED, v. *ĕm-bēd'* [em, in, and *bed*]: to lay deeply in surrounding matter, as in clay, sand, or mortar. **EMBEDDING**, imp. **EMBEDDED**, pp. sunk in and surrounded by another substance. **EMBEDMENT**, n. *-mĕnt*: also spelled **IMBED**.

EMBELIA, n. *ĕm-bĕl'i-a* [Ceylonese name of one of the species] genus of plants, type of the tribe *Embelieæ*, a tribe of *Myrsinaceæ*. About 20 species are known.

EMBELLISH, v. *ĕm-bĕl'lish* [F. *embellir*, to adorn; *embellissant*, adorning, beautifying—from *em*, in or on, and *belle*, beautiful; OF. *bel*, fair—from L. *bellus*, pretty] to decorate; to beautify; to adorn. **EMBELLISHING**, imp. **EMBELLISHED**, pp. *-lîsh't*: ADJ. decorated; beautified. **EMBELLISHMENT**, n. the act of adorning; anything that adds beauty or elegance; ornament; decoration. **EMBELLISHER**, n. *-er*, one who.—SYN. of ‘embellish’. to deck; enrich; illustrate; grace; ornament.

EMBER-DAYS—EMBEZZLE.

EMBER-DAYS, n. *ēm'bēr-* [Ger. *quatember*, a corruption of the L. *quatuōr tempōrā*, the four seasons: Low Ger. *tamper*; Sw. *ymber-dagar*, ember- or imber-days]: certain days set apart by the church for fasting at the four seasons of the year—viz., every quarter; in the church calendar, certain fast-days for imploring a blessing on the ordinations performed at those times. According to the *Book of Common Prayer* of the Church of England, three days are appointed four times in the year to be observed as days of fasting and abstinence; these days are the Wednesday, Friday, and Saturday after the Sunday first in Lent, after the feast of Pentecost or Whitsunday, after Sep. 14, and after Dec. 13. The term ‘embering’ has been variously derived from the Greek *hēmera*, day, and from the embers or ashes which in the earliest times were strewed over the head at seasons of fasting, in token of humility and self-condemnation. But the more correct derivation would appear to be from the Saxon *Ymbrine dagas*, from the Saxon *ymb*, about, and *ryne*, a course or running, the term applied to these fasts because they came round at certain set seasons in the year.—Somner, *Dictionarium Saxonum*. This phrase is used in the laws of Alfred the Great, also of Canute, and corresponds with the term used by the canonists, *jejunia quatuor temporum*, the fasts of the four seasons. Somner says that the embering days were ‘times of old chosen and set apart for fasting and prayer for obteyning the fruits of the earth, and to give thanks for the same, whereas at those times they are either sown, sprung up, coming in their ripenesse, or gathered into the barne, as also to obtaine the grace of the Holy Ghost, when holy orders are given and ministers made.’ It is to this latter purpose that the Church of England in the present day particularly devotes the ember days, and a special prayer is appointed for use at those seasons.

EMBERIZA and **EMBERIZI'DÆ**: see BUNTING.

EMBERS, n. plu. *ēm'bērz* [AS. *æmyric* or *æmyrian*; Dan. *emmer*; Sw. *morja*, hot or glowing ashes]: cinders still hot; the expiring residuum of a fire.

EMBEZZLE, v. *ēm-bēz'l* [*em*, to make, and OE. *bazzle*, to guzzle, to drink hard: OF. *besiller*, to overturn, to destroy: comp. Gael. *an-beusail*, dishonest, immoral—*lit.*, to waste or destroy]: to misappropriate the money of an employer; to apply to one’s own use money held in trust. **EMBEZ'LING**, imp. *-bēz'ling*, making away by a servant with property intrusted to him by his master. **EMBEZ'ZLED**, pp. *-bēz'ld*. **EMBEZ'ZLEMENT**, n. *-bēz'l-mēnt*, felonious appropriation by clerks, servants, or others in a position of trust, of goods, money, or other chattels intrusted to their care, or received in the course of their duty, on account of their employers. **EMBEZ'ZLER**, n. *-bēz'lér*, one who.—*Embezzlement* not being a crime under the English common law, was made such by statute at an early day. It is intended to embrace the stealing of property by servants, agents, public officers and others intrusted therewith, and is a species of a larger offense known in the law as larceny (q.v.). The earliest Eng-

EMBITTER—EMBLEMATA.

lish statute was that of 21 Hen. VIII. c. 7, enacted 1529, and provided in substance that servants having effects delivered to them by their masters or mistresses to keep, and going away with or embezzling them to the value of 40 shillings, should be guilty of felony. An exception was created in favor of apprentices and persons under 18 years of age. Subsequent English statutes are: 39 Geo. III. c. 85 (1799), 7 and 8 Geo. IV. c. 29 § 47 (1827), and the act now in force in England, 24 and 25 Vict. c. 96. See BANKRUPT.

In American law this offense varies according to the statutes in the different states, but it may be comprehensively defined as the fraudulent appropriation of property by a person to whom it has been intrusted. The necessary elements constituting it are: the property must be taken by the offender in the ordinary course of his employment, and must, unless the statutes prescribe otherwise, have come into his hands by virtue of such employment. The property must come from a third party into the offender's possession, before it reaches the master. Embezzlement has been made a felony in the majority of the American states. The crime in its various forms is punishable also under federal law.

EMBITTER: see IMBITTER.

EMBLAZE, v. ēm-blāz' [see EMBLAZON]: in *OE.*, to blazon; to adorn with gaudy or glittering ornaments. EMBLAZ'ING, imp. EMBLAZED', pp. -blāzd'.

EMBLAZON, v. ēm-blā'zn [em, on; F. *blasonner*, to blazon a coat of arms (see BLAZON 1)]: to adorn with figures of heraldry; to adorn with glaring colors; to display pompously. EMBLA'ZONING, imp. adorned with armorial figures: N. the act of adorning with armorial figures or ensigns. EMBLA'ZONED, pp. -blā'znd, adorned with armorial figures or ensigns. EMBLA'ZONMENT, n. -zn-mēnt, the act of blazoning. EMBLA'ZONRY, n. -zn-rī, pictures on shields; display of figures.

EMBLEM, n. ēm'blēm [F. *emblème*—from L. and Gr. *emblēmā*, inlaid work—from Gr. *emballo*, I cast in or insert—*lit.*, that which is inserted into the substance of another body]: an object which while representing one thing to the eye represents another to the understanding; a figure; a type; a symbolical representation. The meaning of the emblem rests upon its secondary, not its primary significance. Emblem is used often in a sense synonymous with the wider word symbol (q.v.). EM'BLEMAT'IC, a. -blē-mēt'ik, or EM'BLEMAT'ICAL, a. -i-kūl, consisting of or containing an emblem; figurative; allusive. EM'BLEMAT'ICALLY, ad. -lī. EMBLEMIZE, v. ēm'blēm-īz, to represent by emblems. EM'BLEMI'ZING, imp. EM'BLEMIZED, pp. -īzd.—SYN. of 'emblem': symbol; sign; signal; device.

EMBLEMATA, ēm-blē'ma-ta [Gr.]: the works of art with which gold and silver vessels were decorated by the ancients. These sculptured figures were generally executed either in the precious metals or in amber. They were called *crustæ* by the Romans, though the Greek word also was used.

EMBLÉMENTS—EMBOLISM.

EMBLEMANTS, n. plu. ēm'blē-mēnts [F. *emblaver*; OF. *embléer*, to sow a field with corn: F. *blé* or *bled*, corn]: in law, growing crops of cereal and vegetable productions raised by the labor of the cultivator and to which the outgoing tenant has claim.

The doctrine of E. applies to tenants for life (see LIFE-RENT), and other tenants of estates of *uncertain* duration, excepts tenants at sufferance. It is derived from the feudal law whereby, when a tenant for life died between March and August, his heirs were entitled to the profits for the whole year. The purpose is to enable the tenant after the expiration of his tenancy to gather the reward of his industry expended upon the soil. It is only annual crops, or such as require annual planting or renewal, as distinguished from permanent grasses, trees, and roots, which are the subjects of E. If the estate of the tenant is of uncertain duration, no right to E. is created, even in growing crops; the reason being, that as the tenant knows when his estate must come to an end, it is an act of folly on his part to plants crops which he will be unable to gather. The tenancy in order to give a right to E. must be ended by no act of the tenant. To obtain the E. the tenant in whose favor the right exists may go upon the land and perform the necessary duties in respect to the crops, and gather the same. The law of E. is governed very materially by local customs and usages which vary in different agricultural localities.

EMBLICA, ēm'blī-ka: a genus of plants of the nat. ord. *Euphorbiaceæ*, having a fleshy fruit. *E. officinalis* is a tree found in most parts of India, with a crooked stem, thinly scattered spreading branches, long narrow leaves, minute greenish flowers, and a globular fruit about the size of a gall-nut. The fruit is very acid, and somewhat astringent, which qualities it retains when dry and shriveled. It is used in India as a deobstruent and febrifuge, also for tanning leather, and making ink, and is generally called *Emblic Myrobalans*.

EMBODY, v. ēm-bōd'i [em, in or on, and body]: to collect into one mass or whole; to incorporate. EMBOD'YING, imp. EMBOD'IED, pp. -id, invested with body; massed into orderly arrangement out of a number of individuals, as troops. EMBOD'IMENT, n. -i-mēnt, the act of uniting into a whole out of a number of individuals or units: a former spelling, IMBODY.

EMBOIL, v. ēm-boyl' [em, to make, and boil]: in *OE.*, to move violently and intensely, as a boiling liquid.

EMBOLDEN, v. ēm-bōld'en [em, to make, and bold]: to give boldness or courage to. EMBOLD'ENING, imp. EMBOLD'ENED, pp. -ēnd, encouraged.

EMBOLISM, n. ēm'bō-līzm [OF. *embolisme*, an addition, as of a day into a year—from Gr. *embolē*, an insertion; *embolisma*, anything put in, a patch—from *em*, in; *ballō*, I cast]: in *med.*, the process by which a thrombus or clot undergoes disintegration into minute particles which are arrested in the capillary circulation; the insertion of days,

EMBOLISM—EMBOSS.

months, or years, into an account of time to produce regularity. EMBOL'IC, a. -*bōl'ik*, and EM'BOLIS'MIC, a. -*lis'mik*, pertaining to. EMBOLISMIC YEAR, applied to the year in which additional months are required to fill up the lunar cycle.

EM'BOLISM, in Medical Science: plugging up of a blood-vessel by a clot of coagulated blood-fibrine, by a detached shred of a morbid growth from a diseased cardiac valve, etc. It is chiefly in cases of ill-nourished, broken-down constitutions, or after protracted or debilitating illness, that the morbid tendency of the fibrin to coagulate spontaneously within the veins exists, and in such cases very trivial circumstances may call it forth, especially if they lead to any pressure on the vessel. Clots, or portions of a clot, may be transported by the blood-current from the venous system to the right side of the heart, and block up the pulmonary artery either entirely or in part: if the occlusion is entire, sudden death is produced; while, if it is only partial, gangrene, or inflammation of a part of the lung, commonly ensues. Many of the sudden deaths of women in child-bed (till recently inexplicable) are due to this cause, the plug being formed in the inflamed uterine veins, or possibly, in some cases, in the right side of the heart, and passing thence to the spot where its arrest proves suddenly fatal. Several cases of this kind are reported in Simpson's *Obstetric Memoirs*. Similar accidents may befall the arterial system. A detached fragment of a diseased tricuspid or aortic valve of the heart, or a separated fragment of coagulated fibrin, may be driven onward in the blood-current, and enter and occlude some of the cerebral arteries, causing softness of the brain, by cutting off the due supply of nourishment. See an exhaustive treatise on this subject by Cohn, entitled *Ueber embolischen Krankheiten*.

EMBOLUS, n. ēm'bō-lūs [Gr. *embolōn*, a bolt, a piston]: the movable part of a pump or a syringe, also called the *piston* or *sucker*; in mech., a wedge.

EMBONPOINT, n. āng'bōng-pwōng' [F.—from *en bon point*, in good condition]: stoutness of person; a full fleshy figure.

EMBORDER, v. ēm-bōr'dér [*em*, on, and *border*—which see]: to adorn with a border.

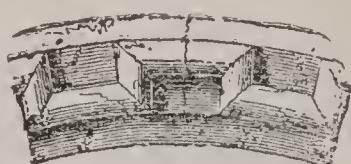
EMBOŠOM, v. ēm-búz'ūm [*em*, in, and *bosom*]: to hold in the bosom; to caress; to inclose in the midst, generally said of trees; to surround. EMBOS'OMING, imp. EMBOS'OMED, pp. -ūmd: also spelled IM-.

EMBOSS, v. ēm-bōs' [OF. *emboister*, to joint, to box in—from *boiste*, a box]: in *OE.*, to box up; to inclose; to incase.

EMBOSS, v. ēm-bōs' [Sp. *embozar*, to muffle the face, to cast out of the mouth: F. *bouche*, a mouth]: in *OE.*, to press a wild animal so much in the chase as to cause it to foam freely. EMBOS'SING, imp. EMBOSSED', pp. -bōst'. said of a deer foaming at the mouth from hard running.

PLATE 20.

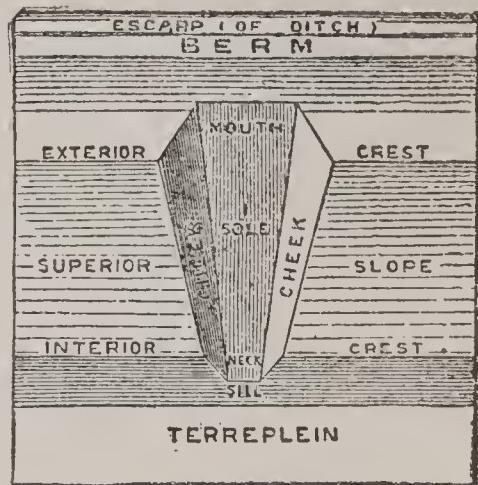
Embalming
Encarpus



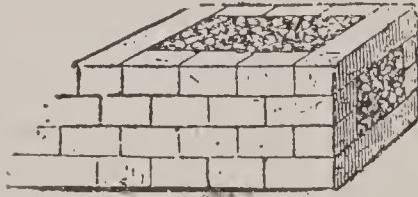
Embattled Molding.



Embalming. — Mummy Case of Queen Ahmes Nofretari: Height 9 feet.—From Maspero's *L'Archéologie Egyptienne*.



Embrasure.



Emplecton.



Encarpus, from Palazzo Niccolini, Rome.

EMBOSS.

EMBOSS, v. *ěm-bōs'* [OF. *embosquer*; Sp. *emboscar*; It. *imboscare*, to hide in a wood]: in *OE.*, to hide or conceal in a wood or thicket; to plunge into deeply.

EMBOSS, v. *ěm-bōs'* [F. *embosser*, to swell or rise in bunchedes; *bosse*, a hump or boss (see Boss 1)]: to cover with raised ornamental work; to form with bosses or protuberances. **EMBOS'SING**, imp.: N. the forming of raised ornaments on any surfacee of paper, leather, wood, metal, etc. **EMBOSSED'**, pp. *-bōst'*, having embossments. **EMBOS'SER**, n. one who. **EMBOSS'MENT**, n, raised work: figures in relief.—Embossing is usually effected by pressing the substance into a die, the kind of die and mode of applying the pressure being modified according to the nature of the design and the properties of the substance to be embossed. Sheet-metal is embossed by stamping it between a pair of steel dies, one in relief, the other in intaglio: see **DIE-SINKING**. When the pattern is a deep one, several pairs of dies are used, and several blows given with each, the metal being occasionally annealed. The first stamping produces a crude resemblance to the final design, of moderate depth; successive stampings bringing up more of the details, and giving increased depth. The upper die is usually raised by a rope, attached over a pulley to a stirrup, in which the workman places his foot; he draws his foot down to raise the heavy die to the required height, and then suddenly releases the pressure of his foot from the stirrup, when the die descends by its own weight. While thus raising the die with his foot, he adjusts the work in its place with his hands. Smaller work is embossed with a screw-press, the lever of which is turned with one hand, while the work is placed under the dies and removed by the other. Paper and card are embossed in a similar manner, but the dies are frequently of brass, sometimes of copper electro-deposits, suitably backed. The counter die is commonly made of soft metal, card or mill board, pressed into the metal intaglio die until a sharp impression is produced. The paper or card is well damped and a fly-press is generally used. The leather or cloth for bookbinding is embossed in this manner, the counter-die being usually made by gluing several pieces of millboard together, and gluing them to the upper bed of the press, then stamping these into the lower die until a perfect impression is obtained. The embossing press designed and constructed by Edwin Hill, for impressing the medallion upon postage envelopes, is a very elaborate and beautiful machine, which inks the die itself, and with the aid of two boys, to place and remove the envelopes, embosses 60 envelopes in a minute. When large surfacees of textile fabrics, such as table-covers, etc., have to be embossed, the fabric is compressed between rollers, one being of metal, upon which the device is sunk like a die; the counter-roller or bed-cylinder is of paper covered with felt; this yields sufficiently to allow the fabric to be pressed into the die-cylinder. A third smooth metal roller is commonly used to press out again the impression made upon the bed-cylinder;

EMBOUCHURE—EMBOWEL.

this acts upon the bed-cylinder on the side from which the fabric emerges. Paper is sometimes embossed in this manner; and the flattening roller may be dispensed with if the cylinders are sufficiently accurate in their diameters for the pattern always to fall on the same place at each successive revolution. Leather embossed in high relief has been used for ornamental purposes in place of wood-carving on picture-frames, cabinet-work, etc. The dies are of type-metal or electro-deposits, and the leather is softened or fulled, i.e., worked with water till it contracts and thickens, then it is pressed into the dies by suitable round pointed tools, like modelling tools, made of wood, bone, or copper. When dry, the leather is removed from the molds, and by its elasticity and shrinking it will relieve from very deep and undercut designs.—Straker's mode of embossing wood differs from all the above, and is very curious and ingenious. When wood is pressed and rubbed with a blunt instrument, the surface yields, and a depression of some depth may be made in it; if the wood be now soaked in water, the depressed portion will rise again to its original level. The process takes advantage of this property thus: The embosser rubs down the surface in those parts that are to be finally in relief; he then planes or shaves away the uncompressed portions until the bottom of the depressions are reached and made level with the new surface; the wood is then soaked; the compressed parts rise to their original level, and, of course, in doing so, rise above the portions that have been planed away, and present the required device in relief.

EMBOUCHURE, n. *ĕm'bō-shōr* or *āng'bō-shōr'* [F.—from *bouche*, a mouth]: the mouth of a river; that part of a river where it discharges itself into a sea or lake; the mouth of a cannon, or that part of a wind musical instrument, to which the lips are applied.

EMBOUND, v. *ĕm-bownd'* [*em*, in, and *bound*]: in *OE.*, to shut in; to inclose.

EMBOW, v. *ĕm-bow'* [*em*, in, and *bow*]: in *OE.*, to bend



Counter-embowed.



Embowed.

like a bow; to arch. **EMBOWED**, heraldic term for anything bent like a bow. The illustration represents a sinistral arm couped at the shoulder, embowed. When the arm is turned the reverse way, it is said to be counter-embowed.

EMBOWEL, v. *ĕm-bow'ĕl* [*em*, intensive, or with the force of L. *e*, out of, and *bowel*]: to take out the entrails or intestines of an animal; to take out internal parts; to inclose or bury in another substance. **EMBOW'ELLING**, imp. **EMBOW'ELLED**, pp. *-ĕld*, deprived of intestines. **EMBOW'EL-**

EMBOWER—EMBROCATE.

MENT, n. the act of taking out the bowels. EMBOW'ELLER, n. -ēl-ēr, one who.

EMBOWER, v. ēm-bow'r [em, in, and bower]: to shelter with a bower; to place or rest among trees. EMBOW'ERING, imp. -bow'rīng. EMBOW'ERED, pp. -bow'rd.

EMBRACE, v. ēm-brās' [OF. embracer; F. embrasser; It. imbracciare, to enfold in one's arms—from en, in, and F. bras; It. braccia; L. brachium, the arm]: to take or inclose in the arms; to press or clasp to the bosom in token of affection; to seize eagerly; to include or take in; to comprehend; to accept; to admit: N. pressure to the bosom with the arms; a hug; sexual intercourse. EMBRA'CING, imp. EMRRACED', pp. -brāst'. EMBRA' CER, n. -sér, one who. EMBRA'CERY, n. -sér-ī, in law, an attempt to corrupt jurors or referees to one side by money, or by promises of money, or any improper influence. This offense is a species of maintenance (q.v.). It is properly regarded as a high crime. The giving of money to be distributed among jurors is embracery, though the money be not actually distributed. Not only persons attempting to influence the jury, but jurors themselves attempting unduly to bias the minds of their fellows, are guilty of embracery. The using indirect means in order to be sworn on a jury, is also embracery. EMBRACE'MENT, n. -mēnt, in OE., an embrace; conjugal endearment; reception.—SYN. of 'embrace, v.': to comprise; contain; include; involve; imply; clasp; hug; inclose; encircle; encompass; surround; welcome.

EMBRASURE, n. ēm-brā'zhūr [F. embraser, to set on fire—from braise, glowing embers; embrasure, the splayed opening of a window or door for more light—lit., a window from which fire is hurled]: in fortification, an opening in a parapet, flank of a bastion, or other part of defense-works, through which cannon are pointed. The siege-batteries of the enemy also have embrasures. Their use is, to shield as much as possible the guns, gun-carriages, gunners, and interior of the place, and yet leave spaces for the free aiming firing of the guns. Each opening slopes outward, so as to give greater sweep to the gun's action.—The sloping or spreading sides of a door or window in any wall also are called embrasures.

EMBRAVE, v. ēm-brāv' [em, in, and brave]: to inspire with fortitude; to adorn; to embellish.

EMBROCATE, v. ēm'brō-kāt [mid. L. embrocātus, poured into a vessel: It. embrocatione, a fomenting the head with a liquid falling upon it in the manner of rain—from It. broca; F. broc, a jug or pipkin: Gr. embrōchē, a steeping, an embrocation]: to moisten and rub a diseased part with a liquid medicine. EM'BROCATING, imp. EM'BROCATED, pp. EM'BROCA'TION, n. -kā'shūn [F.—L.]: the act of bathing and rubbing a diseased part with a liquid medicine; a lotion or mixture so employed: see LINIMENT.

EMBROIDER.

EMBROIDER, v. *ém-broy'dér* [*em*, in or on, and F. *bordure*, the welt or hem of a garment; *broder*, to embroider]: to adorn with ornamental needle-work. EMBROI'DERING, imp.: N. the art of adorning, as cloth with needle-work. EMBROI'DERED, pp. *-dérēd*, adorned with ornamental needle-work. EMBROID'ERER, n. *-ér-ér*, one who. EMBROID'ERY, n. *-éri*, art of producing ornamental needlework-patterns upon fabrics of any kind; also, the product of such work. This art is coeval with the earliest and rudest manufacture of hair and woolen fabrics. It was one of the most important of the early arts in Oriental countries, where it is still practiced with great skill and diligence. It is common among the savage tribes that wear any kind of clothing. The blanket-wrapper of the Red Indian is commonly ornamented with embroidery; the Laplander embroiders upon the reindeer skin that forms his garments patterns worked with needles of reindeer bone, and thread of reindeer sinews and strips of hides. It is practiced as a domestic art, and is carried on in large manufactories by elaborate machinery.

The Chinese are perhaps the most laborious and elaborate hand-embroiderers of modern times; their best work is upon silk. The figures are either in colored silk alone, or in silk combined with gold and silver thread; the figures of men, horses, dragons, etc., being outlined with gold cord, and filled up colored and shaded with silk. The Persians, Turks, and Hindus also still excel in embroidery; they use, besides silk and gold and silver thread, beads, spangles, pearls, and precious stones. The dress-slippers of Turkish women of all ranks are elaborately embroidered, usually with a precious stone or a glass bead in the middle of the toe-part of the slipper, and a radiating pattern in gold, silver, and brass wire and silk surrounding it. The Turkey carpet is a sort of embroidered fabric: see CARPETS.

Some of the Oriental and Indian embroiderers include in their work a great variety of materials besides those above mentioned; feathers are largely and very tastefully used; skins of insects; nails, claws, and teeth of various animals; nuts, pieces of fir, skins of serpents, etc., are among these. Coins, commonly used as ornaments for the hair of unmarried women in the East, are sometimes also worked into their dresses with the embroidery—especially among the Turks and Georgians. The Indian women embroider with their own hair and that of animals.

Tapestry is a kind of embroidery, formerly with the needle, now chiefly with the shuttle. This kind of work, being intermediate between embroidery and weaving, is somewhat difficult of classification: see TAPESTRY.

For hand-embroidery by the needle, the fabric is usually stretched upon a frame, and the design to be worked is drawn upon it, or some other contrivance is used to guide the worker. If the fabric is sufficiently thin and open, a colored drawing or engraving may be placed behind the work, and followed with the needle. A sheet of thin transparent paper, with lines upon it corresponding to the threads of the canvas to be worked upon, is sometimes used: this is

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secured by gum or wax to the drawing; and the design is copied by observing the number of small squares occupied by each color, and filling in the corresponding meshes of the canvas. *Berlin-work*, a kind of embroidery, is done in similar manner, the pattern being an engraving on which the lines corresponding to the thread are printed, and the meshes filled up with the required colors, painted in by hand by women and children, who copy it from the original design of the artist. The name has been given from the fact, that the best patterns have, since 1810, been published by Wittich, printseller in Berlin.

In France, pricked patterns are sometimes used, one for each color, and colored powders are dusted through the holes upon the fabric to be worked.

All these devices render the art of embroidery a mere mechanical operation, requiring no further artistic skill or taste than is exercised in knitting stockings; but when the embroidress draws the design in outline upon the fabric, and works in the colors with her needle under the guidance of her own taste, embroidery becomes an art that might rank with water-color drawing or oil-painting.

Muslin-embroidery, much in vogue of late, is purely mechanical work. The muslin is printed with a pattern made up of holes of different dimensions; these are cut or punched out, and their edges sewn with a 'button-hole stitch.' This kind of work is much used as trimming for ladies' clothing, for collars, and children's clothes.

Machine-embroidery has been practiced with considerable success during the last quarter century. A machine was exhibited in the French Industrial Exhibition 1854, by M. Heilmann of Mulhausen, by which one person could guide from 80 to 140 needles, all working at the same time, and producing so many repetitions of the same design. Though the details of the construction of this machine are rather complex, the principle of its action may be easily understood. The needles have their eyes in the middle, and are pointed at each end, so that they may pass through from one side of the work to the other without being turned. Each needle is worked by two pairs of artificial fingers or pincers, one on each side of the work; they grasp and push the needle through from one side to the other. A carriage or frame connected with each series of fingers does the work of the arm, by carrying the fingers to a distance corresponding to the whole length of the thread, as soon as the needle has passed completely through the work. The frame then returns to exactly its original place, and the needles are again passed through to the opposite set of fingers, which act in like manner. If the work were to remain stationary, the needles would thus pass merely backward and forward through the same hole and make no stitch; but by moving the work as this action proceeds, stitches will be made, their length and direction varying with the velocity and the direction in which the work moves. If 140 needles were working, and the fabric were moved in a straight line, 140 rows of stitching would be made; if the work made a circular movement, 140 circles would be em-

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broidered; and so on. In order, then, to produce repetitions of any given design, it is only necessary to move the fabric in directions corresponding to the lines of the design. This is done by connecting the frame on which the work is fixed to an apparatus similar to a common pantagraph, or instrument so constructed that one end repeats on a smaller scale exactly the movements which are given to the other: see PANTAGRAPH.

Although it is *possible* to embroider any design with such machines, there are only certain designs that can be worked economically; for to do this, the patterns must be so designed as to consume each needleful of silk without waste. The length of silk required for each color can be calculated with extreme accuracy, and the designer is usually limited by this requirement. A greater range is, however, obtainable by dyeing the same thread of silk in different colors, the length of each color corresponding to what is required for producing the pattern; but a large demand for each pattern is required to render this profitable.

EMBROIL, v. *ěm-broyl'* [F. *embrouiller*, to perplex, to entangle—from *em*, in; *brouiller*, to jumble, to mix]: to involve in troubles or perplexities; to entangle; to distract. **EMBROIL'ING**, imp. **EMBROILED'**, pp. *-broyld'*. **EMBROIL'MENT**, n. confusion; disturbance.—SYN. of ‘embroil’: to perplex; encumber; mingle; disturb; trouble; disorder; confound.

EMBRUE, v. *ěm-brō'*: see IMBRUE.

EMBRUN, *ěm'brūn* F. *ǒng-brǔng'*: town of France, dept. of Hautes Alpes, on a platform of rock in the midst of a plain, on the right bank of the Durance, 20 m. e. of Gap. From a distance, the town has an imposing appearance. The streets of E. are narrow, dirty, and irregular. It is surrounded by loopholed ramparts and ditches, and strengthened by bastions. The principal buildings are the cathedral, a Gothic edifice, surmounted by a lofty Romanesque tower, and the barrack, formerly the archbishop's palace. E. manufactures broadcloth, counterpanes, hats, cotton-yarn, and leather. E. occupies the site of the anc. Ebrodunum, cap. of the Caturiges, an important Roman station. The line of its archbishops can, it is said, be traced to the time of Constantine. In modern times E. has been thrice destroyed by fire: by the Moors 966, during the religious wars 1573, and by the Duke of Savoy 1692. Pop.(1891) 4,481.

EMBRYO, n. *ěm'bri-ō*, **EM'BRYON**, n. *-ōn* [F. *embryon*—from Gr. *embrūōn*, an infant in the womb—from *em*, in; *brūō*, I shoot or bud—*lit.*, that which forms or swells inside something]: an organized being in a rudimentary condition, or the rudiment from which, under proper conditions, an organized body is to be developed. In botany, the term embryo is applied to the germ formed within the ovule on fertilization, and which increases to become the principal part of the seed. The albumen or perisperm of the seed, being regarded as a mere store of nourishment for the embryo, is not accounted part of the embryo; the cotyledons,

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however—though a large store of nourishment is often laid up in them—are considered as essentially belonging to it, with the *plumule*, the *radicle*, and the connecting parts. As to animals, the term embryo is used as equivalent with *fætus*, and as designating the rudimentary animal from the moment of impregnation until the egg is hatched; but though this takes place at very different stages of development in different kinds of animals, and consequent metamorphoses are undergone by some before they reach their perfect state, the term embryo is not applied to the *larvæ* and *pupæ* of insects, or to the analogous states of other classes of animals. Eggs contain, with the embryo, a store of nourishment for it in the earlier stages of its development. See REPRODUCTION: DEVELOPMENT OF THE EMBRYO: EGG: FŒTUS: OVULE: SEED: SPORE.—Embryo is applied figuratively to the first state or beginning of anything; anything before it assumes its distinct form: ADJ. rudimentary. EM'BRYON'IC, a. -*ōn'ik*, or EM'BRYON'ARY, a. -*ēr'i*, and EM'BRYON'AL, a. -*ōn'āl*, relating to an embryo; rudimentary. EM'BRYOG'ENY, n. -*ōj'ē-nī* [Gr. *genos*, offspring, race]: in bot., the development of the embryo in the ovule. EM'BRYOL'OGY, n. -*ōl'ō-jī* [Gr. *logos*, a discourse]: the study of the formation of the embryo (see DEVELOPMENT OF THE EMBRYO). EM'BRYOL'OGIST, n. -*jist*, one who is versed in. EM'BRYOT'OMY, n. -*ōt'ō-mī* [Gr. *tōmē*, a cutting]: division of the fetus into fragments, by incision, with its extraction in pieces, when narrowness of the pelvis or other faulty conformation opposes delivery. EMBRYO-BUDS, nodules in the bark of the birch and other trees. EMBRYO-SAC or EMBRYONARY-SAC, the cellular bag in which the embryo is found. EM'BRYOT'EGA, n. -*ōt'ē-gă* [Gr. *tegos*, a covering]: a process or callosity raised from the spermoderm by the embryo of some seeds during germination, as in the bean.

EMBURY, ēm'bér-i, PHILIP: 1729, Sep. 21—1775, Aug.; b. Ballygaran, Ireland: father of American Methodism. He was educated in a local school, learned the carpenters' trade, joined the Meth. Church 1752, appointed a local preacher of Wesley's society at Court Mattréss, Ireland, 1758, emigrated to New York 1760, and worked at his trade till 1766, when, at the instigation of Barbara Heck, he began preaching in his own house. At first his auditors were chiefly of his Irish countrymen, but as others were attracted to his services he opened a meeting-room in an old sail-loft on the present William street, and preached there till he had gathered a congregation large enough to warrant the erection of a church. In 1768 the first Methodist church in the United States was built on John street, E. doing a large part of the carpenter work himself, and building his own pulpit, from which he dedicated the structure Oct. 30. He preached there gratuitously till 1769, when he resigned the charge and removed to Camden (now Salem), Washington co., N. Y., where he worked at his trade and founded another church, the germ of the present Troy conference of the Meth. Episc. Church.

EMDEN, ēm'dēn: town in the province of Hanover, formerly in the principality of East Friesland, a little be-

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low the embouchure of the Ems into Dollart Bay; lat. 53° 22' n., long. 7° 13' e. It lies low, but is protected by strong dikes from inroad of the waters of the bay. Nevertheless, occasional inundations take place; as in 1826, when for three months the water was as high as the first floor of the houses. E., which is the chief commercial town of Hanover, is surrounded by walls and towers, is well built, has spacious and well paved streets, and houses remarkable for their appearance of comfort, and for extreme cleanliness. It is intersected by numerous canals, which are crossed by about 30 bridges. The Delf canal runs s. from the town to Dollart Bay, about two m., but it can be entered at high water only, and even then is not navigable for vessels of more than 13 or 14 ft. draught; all vessels of greater draught having to unload in the roadstead of Delf, at the mouth of the canal. The principal building, and one of the finest public edifices in the whole region, is the town-hall, containing a library and a curious collection of ancient arms and armor. E. stands in a district of great fertility. It has much of ship-building, besides various other manufactures. From this town, from 50 to 60 vessels are sent out to the herring-fishing off Scotland. E. was made a free port 1751, came into the possession of Holland 1808, and with the whole of E. Friesland, was incorporated with the kingdom of Hanover 1815. Pop. (1880) 13,667; (1890) 13,695.

EMEND, v. ē-měnd' [F. émender—from L. emendārē, to correct; *emendātus*, corrected—from *e*, out of; *mendum*, a fault: It. *emendare*]: to make corrections on a literary work. **EMENDATION**, n. ēm'ēn-dā'shūn, the act of altering or changing for the better; correction of an error or fault; improvement. **EMENDATOR**, n. -tér, one who corrects errors in writings, or improves them. **EMENDATORY**, a. -dā-tér-ī, contributing to emendation.—SYN. of ‘emend’: to amend; correct; reform; rectify; improve; better; perfect.

EMENDALS, n. ē-měnd'als: term in old accounts, signifying the sum total in stock.

EMERALD, n. ēm'ēr-äld [Sp. *esmeralda*; L. *smaragdus*; Gr. *smaragdos*; OF. *esmeraude*; F. *émeraude*: name originally Semitic, or at least eastern, but signification unknown]: mineral generally regarded by mineralogists as merely another variety of the same species with the beryl (q.v.), with which it essentially agrees in composition, crystallization, etc., differing from the beryl only in greater brilliancy of color. The E., which, as a gem, is very highly valued, owes its value chiefly to its extremely beautiful velvety green color. It is composed of about 67–68 per cent. of silica, 15–18 of alumina, 12–14 of glucina and a very little peroxide of iron, lime, and oxide of chromium. Its color is ascribed chiefly to the oxide of chromium. Its specific gravity is 2·577–2·725. In hardness it is slightly inferior to topaz. The localities in which E. is found are very few. The finest emeralds have long been brought from S. America, where they are obtained from veins traversing clay-slate, horn-blende slate, and granite, in & vey not far from Santa Fé de Bogota. Emeralds of iu-

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ferior quality are found in Europe, imbedded in mica-slate in the Henbach Valley in Salzburg. They are found also in the Ural; in old mines in Upper Egypt; large and fine in N. Carolina; light-yellow in Alabama; and aquamarine in Colorado. This gem, known from very early times, was highly prized. Pliny states that when Lucullus landed at Alexandria, Ptolemy offered him an E. set in gold, with his portrait engraven on it. Many wrought emeralds have been found in the ruins of Thebes. Nero, who was near-sighted, looked at the combats of gladiators through an eye-glass of E., and concave eye-glasses of E. seem to have been particularly esteemed among the ancients. As a precious stone, the E. is rarely without flaw. Its value depends much on its color. A very perfect E. of six carats has been sold for \$5,000.

It is probable that emeralds have been found in the East, in localities not at present known, but the name E. or ORIENTAL E. is often given to a very rare, beautiful, and precious green variety of SAPPHIRE (q.v.).

E. COPPER is a beautiful and very rare E. green crystallized mineral, called also DIOPTASE, found only in the Kirghis Steppe, and composed of about 39 parts silica, 50 protoxide of copper, and 11 water.

EMERALD ISLE, name applied to Ireland in reference to its bright verdure.

EMERGE, v. ē-merj' [L. *emergērē*, to rise up, to come forth—from *e*, out of; *mergo*, I plunge or dip]: to rise up from beneath a surface, as of water; to rise from a low to a higher station or condition; to issue; to proceed from; to reappear; to rise into view; to become a reality. EMERGING, imp. EMERGED', pp. -merjd'. EMER'GENT, a. -mér'-jént, rising out of; coming suddenly; pressing. EMER'-GENTLY, ad. -lī. EMER'GENCE, n. -jéns, or EMER'GENCY, n. -jén-sí, that which comes suddenly; a sudden occasion; anything calling for immediate action; pressing necessity. EMERSION, n. ē-mér'shún [L. *emersus*, risen up]: the act of appearing to view; in *astron.*, reappearance of one heavenly body from behind another, after an eclipse or occultation. The immersions and emersions of Jupiter's first satellite are particularly useful for finding the longitude of places. Minutes or scruples of emersion are the arc of the moon's orbit passed over by her centre, from the time she begins to emerge from the earth's shadow to the end of the eclipse. EMERGENT-YEAR, n. epoch or date from which any people begin to compute their time.

EMERITUS, a. ē-mér'i-tús [L. *emeritús*, a veteran—from *e*, out of; *mérēō*, I deserve; It. *emerito*; F. *émérite*]: honorably relieved from public duty on account of age or long and faithful services—said of a professor in a college, or the pastor of a church, relieved but retained in connection.

EMERODS, n. plu. ēm'ér-ōdz [a contraction of *hemorrhoids*: Gr. *haimorrhoides*—from *haima*, blood, and *rheō*, I flow]: painful and bleeding tubercles about the anus; piles.

EMERSION: see under EMERGE.

EMERSON.

EMERSON, ēm'ēr-son, RALPH WALDO, LL.D.: 1803, May 25—1882, Apr. 27; b. Boston: philosopher and poet. He was son of William E., pastor of the First Church (Congl.) in Boston, and was in descent the eighth in a line of Puritan ministers. He graduated at Harvard 1821, and taught for several years in a girls' school of which his elder brother was principal, at the same time studying theology. In 1829 he became colleague of Henry Ware in the pastorate of the Second Church (Unitarian) in Boston. A year afterward Mr. Ware was chosen prof. of pulpit eloquence in Harvard College, and E. became sole pastor of the Second Church. Four years afterward he came to the conclusion that the usual mode of administering the Lord's Supper was not merely unwarranted by Scripture, but was also not beneficial to those participating. His congregation were not willing that any change should be introduced; and E. resigned his charge, and early in 1833 sailed for Europe, where he remained nearly a year, mostly in Italy. Before returning to America he went to England and Scotland, his special purpose being to see Carlyle, whom he regarded as 'the strongest contributor to the critical journals.' Carlyle was then residing at the lonely farm of Craigenputtock, 15 m. from any considerable town. The interview, of only a few hours, resulted in a warm friendship, ended only by death.

Returning to America, E. at once began his career as a lecturer. His first lecture on 'Water' was delivered before the Mechanics' Association of Boston; this was followed by three others describing his visit to Italy, then by one on the 'Relations of Man to the Globe.' In 1834, he delivered a series of five lectures upon Michael Angelo, Milton, Luther, George Fox, and Edmund Burke; the first two of which, published in the *North American Review*, were his first appearance in print. In 1835 he married, and took up his residence at Concord, 20 m. from Boston, which was his residence for the remaining 47 years of his life. For 40 years he lectured in all the important towns in the Union; his principal courses being 10 lectures on 'English History,' 12 on the 'Philosophy of History,' 10, on 'Human Culture,' 10 on 'Human Life,' 10 on 'The Present Age,' 7 on 'The Times.' In 1847, he went to Great Britain on a lecturing tour, and delivered a course on 'Representative Men,' and another on 'Mind and Manners in the Nineteenth Century.' None of these courses have been published as a whole, though the subject-matter of some has been embodied in his books.

E.'s published works, arranged in the order of their first publication, are as follows: *Nature*, 1836; *Poems*, 1846; *Essays*, First Series, 1841; Second Series, 1847; *Miscellanies*, consisting of collegiate and other addresses; most of which had already been printed in *The Dial*, 1849; *Representative Men*, 1850; *English Traits*, 1856; *Conduct of Life*, 1860; *May-Day and other Poems*, 1867; *Society and Solitude*, 1870; *Letters and Social Aims*, 1875. Besides these he furnished several chapters of the *Life of Margaret Fuller Ossoli* whom, in 1842, he succeeded as editor of *The Dial*, to which

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he contributed largely during the four years of its existence. Not long after his death two vols. made up from his manuscripts were published, as was also his correspondence with Carlyle.

The two series of *Essays* are the works with which—and his early volume entitled *Nature*—the name of E. is usually associated; though the volume on *Representative Men*—*Plato, the Philosopher*; *Sv denborg, the Mystic*; *Montaigne, the Skeptic*; *Shakespeare, the Poet*; *Napoleon, the Man of the World*, and *Goethe, the Writer*—are quite as characteristic of the author as anything which he ever wrote. The sketch of Plato is clearly the one on which he lavished his best powers. ‘Among books,’ he says, ‘Plato is entitled to Omar’s fanatical compliment, “Burn all the libraries; for their value is in this book.”’ The writings of Plato contain the culture of nations; these are the corner-stone of schools; these are the fountain-head of literatures. . . . No wife, no children has he; and the thinkers of all civilized nations are his posterity, and are tinged with his mind.’

Anything like a system of philosophy cannot be deduced from the utterances of Emerson. In his early manhood he perhaps might properly have been styled an Idealist. In the chapter on Idealism, in *Nature*, he says: ‘A noble doubt perpetually suggests itself, whether Nature outwardly exists. It is a sufficient account of the Appearance we call the World, that God will teach a human mind, and so make it the receiver of a certain number of congruent sensations. In my utter impotence to test the authenticity of the report of my senses—to know whether the impressions they make on me correspond with outlying objects—what difference does it make whether Orion is up there in heaven, or some god paints the image in the firmament of the soul? . . . Whether Nature enjoys a substantial existence without, or is only an apocalypse of the mind, it is alike useful and venerable to me. Be it what it may, it is ideal to me, so long as I cannot try the accuracy of my senses. . . . Three problems are put by Nature to the mind: “What is matter? Whence is it? and Whereto?” The first of these questions only the Ideal theory answers. Idealism saith: “Matter is a phenomenon, not a substance.” Idealism acquaints us with the total disparity between the evidence of our own being and the evidence of the world’s being. The one is perfect, the other incapable of any assurance; the mind is part of the nature of things; the world is a divine dream from which we may presently awake to the glories and certainties of day. Idealism is a hypothesis to account for Nature by other principles than those of carpentry and chemistry. Yet if it only deny the existence of matter, it does not satisfy the demands of Spirit. It leaves God out of me. It leaves me in the splendid labyrinth of my perceptions, to wander without end. Then the heart resists it, because it balks the affections in denying substantive existence to men and women. Nature is so pervaded with human life that there is something of humanity in all, and in every particular. But this theory makes Nature foreign to us,

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and does not account for that consanguinity which we acknowledge to it. Let it stand, then, in the present state of our knowledge, merely as a useful introductory hypothesis, serving to apprise us of the eternal distinction between the Soul and the World.'

E.'s teachings relate almost solely to our present earthly life, in respect to which they are mostly noble and exalted. But he knows nothing of a possible previous existence, and, unlike Plato, he never speculates about any such thing. He has also very little to say of a future life, and that far from definite. He indeed mentions, almost incidentally, that he and Carlyle sat one August morning upon the hillside, and 'talked of the immortality of the soul'—a topic evidently of E.'s suggesting; for, as he says, 'Carlyle did not like to place himself where no step can be taken.' It is clear enough that E. in early manhood accepted the doctrine of the immortality of the soul in its ordinary acceptation. But it is equally clear that in after life his idea of it became far less definite. We find his most matured thought on this subject nowhere so fully expressed as in the chapter on Immortality in his *Letters and Social Aims*. At the very outset he scouts at the idea that any such thing was taught by Jesus. 'It is very strange,' he says, 'that Jesus is esteemed by mankind the bringer of the doctrine of immortality. He is never once weak or sentimental; he is very abstemious of explanation; he never preaches the personal immortality, whilst Plato and Cicero had both allowed themselves to over-step the stern limits of the spirit, and gratify the people with that picture.' His own conclusion as to the immortality of the human soul is thus expressed: 'I confess that everything connected with our personality fails. Nature never spares the individual. We are always balked of a complete success. No prosperity is promised to that. We have our indemnity only in the success of that to which we belong. That is immortal, and we only through that. The soul stipulates for no private good. That which is private I see not to be good. . . . Is immortality only an intellectual quality; or, shall I say only an energy, there being no passive? He has it, and he alone, who gives life to all names, persons, things, where he comes. No religion, not the wildest mythology, dies for him. He vivifies what he touches. Future state is an illusion for the ever-present state. It is not length of life, but depth of life. It is not duration, but a taking of the soul out of time, as all high action of the mind does.'

That E.'s dicta are not always consistent with each other—that he often says one thing at one time and a quite different thing at another time—is beyond question. No one is more prompt to acknowledge this than he himself. He not only acknowledges it, but justifies it. In his essay on Self-Reliance he says: 'One terror that scares us from self-trust is our "consistency," a reverence for past act or word, because the eyes of others have no data for computing our orbit other than our own past acts, and we are loth to disappoint them. . . . Suppose you should con-

tradict yourselves—what then? . . . A foolish consistency is the hobgoblin of little minds, adored by little statesmen and philosophers and divines. With consistency a great soul has little or nothing to do. He may as well concern himself with his shadow on the wall. Speak what you think now, in hard words; and to-morrow speak what to-morrow thinks, in hard words again, though it contradicts everything you said to day. “Ah, so you shall be misunderstood!” Is it so bad, then, to be misunderstood? Pythagoras was misunderstood, and Socrates, and Jesus, and Luther, and Copernicus, Galileo, and Newton, and every wise spirit that ever took flesh. To be great is to be misunderstood.’

This refusal of consistency was characteristic of his whole mental method, which, at least on this point was curiously self-consistent. He was unchangeably transcendentalist and mystic. Thus, in some utterances he was considered to speak as a pantheist, yet the whole trend of his thinking cannot be said to accord with that system nor indeed with any other. He spoke of God, man, and the universe rather from their aspect, than from any set of established convictions regarding their essence and reality. Thus, again, some of his later utterances were claimed by adherents of evangelical Christianity to verge toward that system. They were certainly notable from him; for instance this, from his intimate friend A. Bronson Alcott : ‘I do not care to classify myself with any painstaking accuracy with this sect or with that; but if I am to have any appellation at all of a religious kind, I prefer to be called a Christian theist. You must not leave out the word Christian, for to leave out that is to leave out everything.’ The spirit of such words is certainly genial and Christian, but it is probably unwise to take them as indicating a new philosophical departure. E.’s superb mysticism—lacking power equally for construction or destruction of any system—renders its chief service through its wonderful ethical suggestiveness and its swift glimpses of grand though unrelated truths.

E.’s place as a philosophical thinker may even now be fairly assigned. It is probable that no man of his century exerted a wider influence on the thought of his time. Like Plato, he was not the founder or exponent of any school of philosophy or ethics; but his thinking, like that of Plato, is an enduring force. It is not so easy to assign his place as a poet. Considering that he wrote verse at intervals for more than 30 years, his poetical productions are not numerous: a single small volume would contain all of them. No one poem exceeds about 600 lines, and few have a quarter as many. But there are not a few who hold that were it not for defects in rhythm and metre his place would be with the first poets of his day. Without attempting to fix his exact status, we may say that his poem in memory of his brother, Edward Bliss Emerson, the Threnody for his own dead boy, the May-Day, and the Hymn of Nature, will have a life as long as that of any poem in the English language produced in this century.

EMERY.

Emerson died at Concord, which for nearly half a century had been his home.

EMERY. n. *ém'er-i* [F. *émeri*, a black hard mineral—from It. *smeriglio*: Gr. *smuris*, emery: Sp. *esmerar*, to polish, to cleanse]: variety of corundum (q.v.), or of the same mineral species of which corundum and sapphire (with oriental ruby, etc.) also are varieties. It agrees with them perfectly in composition, hardness, and specific gravity; but is dull, opaque, and not crystallized, sometimes of grayish black, sometimes of blue color. It occurs both massive and disseminated. Its masses, though very compact, have a somewhat granular structure. It is found in several parts of Europe, in Asia Minor, Greenland, etc., generally in masses scattered through aqueous deposits, but in one locality in Saxony in beds of steatite in a schistose rock. The principal European source of E. is the island of Naxos. E. of fine quality is found in Chester, Mass., and other localities. Being very hard, it is much used for grinding glass and polishing metals and other hard substances. It is found in lumps, having a granular structure. It is composed of alumina, oxide of iron, and silica, with a little lime, in proportions varying considerably with different specimens. The following may be taken as an average: alumina, 82; oxide of iron, 10; silica, 6; lime, $1\frac{1}{2}$. The E. of commerce, especially that used in E.-paper etc., is sometimes adulterated with garnet, zircon, and other substances harder than quartz-sand.

It is prepared for use by first breaking it into lumps about the size of a hen's egg, then crushing these to powder by stampers. It is then sifted to various degrees of fineness, numbered according to the meshes of the sieve. Plate-glass manufacturers and others separate E. powder into different degrees of fineness by *elutriation* (q.v.). A number of copper cylinders of graduated capacities are placed in a row, and filled with water; the E., churned up with an abundance of water, is admitted by a pipe into the smallest, it then passes to the next in size, and finally flows from the largest; thus, as a given quantity of water with E. suspended in it, passes in equal times through vessels of varying capacities, the amount of agitation will obviously be greatest in the smallest vessel, least in the largest, and in like proportion with the intermediate; the largest particles, therefore, sink in the smaller vessel, and so on till only the very finest will reach the largest vessel. In this manner, any number of gradations of fineness may be obtained, according to the number and sizes of the vessels. Elutriation in oil or gum-water is sometimes used on a smaller scale, the E. being stirred up in the liquid, and portions poured off at different intervals of time, the finest being, of course, the last to settle. The use of the oil or gum is to make the subsidence take place more slowly.

E. thus prepared is used for a great many important purposes in the arts. Being next in hardness to diamond-dust and crystalline corundum, the lapidary uses it for cutting and polishing many kinds of stone. Glass-stoppers

EMERY—EMETIC.

of all kinds are ground into their fittings with it. Plate-glass is ground flat by its means; it is also used in glass-cutting, and in grinding some kinds of metallic fittings. When used in polishing metals, it has to be spread on some kind of surface to form a sort of fine file. *E. paper* is made by sifting E. over paper which has been covered with a coating of glue. It is used either by wrapping it round a fine file, or a stick, or in the hand, according to the form of the work: see POLISHING OF METALS. *E. cloth* is made like E. paper, with coarse calico substituted for the paper. The E. does not adhere so well as to paper, and it is therefore not used by metal-workers, who work E. paper till smooth with wear, but is used chiefly for purposes where the hand alone is used, and paper would tear. *E. sticks* are used for the same purposes as E. paper wrapped round files; they are made of deal sticks shaped like files, then glued over, and dipped once or twice in a heap of emery. *E. cake*, is a compound of bees-wax, suet, and E., melted and well worked together. It is applied to buffing wheels, etc. *E. stone* is a kind of earthen-ware mixed with E., formed by pressing a mixture of clay and E. into suitable molds and then firing, like common earth-ware. It is molded into wheels, laps, etc. Its hardness and cutting power are considerable. **EMERY-WHEEL**, leaden wheel in which emery is embedded by pressure, or, more commonly, a wooden wheel covered with leather and with a surface of emery. Its principal use is in grinding and polishing metallic articles, especially cutlery.

EMERY, CHARLES EDWARD: civil engineer; b. Aurora, N. Y., 1838, Mar. 29. He entered the U. S. navy as 3d asst. eng. 1861, was promoted 2d asst. eng. 1862, took part in the engagements at Pensacola, on the Mississippi river, and at Mobile, and in the blockade of Charleston, and resigned 1867, Dec. Subsequently he became consulting eng. of the U. S. coast survey and U. S. revenue marine, conducted experiments with chief eng. Charles H. Loring to determine the relative value of compound and non-compound engines, and was appointed eng. of the New York Steam-heating Company 1879. In that capacity he constructed the entire plant of the company, and invented almost all the devices employed in the generation and distribution of the steam. He is a non-resident prof. of Cornell Univ., member of the American Soc. of Civil Engineers and the American Soc. of Mechanical Engineers, and received the degree PH.D. from the Univ. of New York 1879.

EMESA: see HEMS.

EMETIC, n. *é-mét'ik* [F. *émétique*—from Gr. *emetikós*, that causes vomiting—from Gr. *emēō*, I vomit: L. *emetica*, an emetic]: substance which, administered internally, causes vomiting (q.v.). Such substances are given when it is desirable to relieve the stomach of some noxious or indigestible substance, as a narcotic poison, or excess of food, or some special article of diet which has disagreed. Emetics are administered also in cases of fever, where the

EMEU—EMICTION.

copious secretion that they produce from the glands of the stomach and intestines is supposed to have a directly curative effect, aided, perhaps, by the sedative action of emetics upon the circulation and nervous system. There is considerable evidence to show, that emetics have the power of cutting short typhus and other fevers in the earliest stage, and afterward of making the attack of the disease less severe. In diseases of the respiratory organs, emetics are given as the quickest and safest method of removing accumulated mucus from the air-passages; and in croup (q.v.), their action is especially favorable, being often followed by expectoration and rapid improvement in the suffocative symptoms. Emetics are to be given with great caution, however, in all very depressed states of the system, as their primary action is to produce nausea (q.v.), which is attended always with more or less diminution of the vital power, and often with great depression of the heart's action, amounting to syncope or fainting. The principal emetics are the preparations of antimony, zinc, and copper; ipecacuanha in powder or in wine; squill, lobelia, and, generally speaking, the whole class of expectorants and irritants; the latter of which, however, with the exception of sulphate of zinc, and perhaps mustard and water, form a dangerous kind of emetics, which should never be administered when the milder kinds can be procured. EMET'IC, a. that causes vomiting. EMET'ICALLY, ad. -i-käl-i. EMETIN, n. ēm'ě-tin, alkaloid which forms the active principle of ipecacuanha root. It is a yellowish-white powder, slightly soluble in cold water, but dissolving readily in alcohol. When taken internally, it exhibits violent emetic properties, $\frac{1}{20}$ th of a grain being sufficient to cause vomiting. See IPECACUANHA.

EMEU: see EMU.

ÉMEUTE, n. ā-mūt' [F. émeute, an uproar—from L. *exmōtā*, that which is disturbed—from L. *e*; *mōtus*, a moving]: a tumultuous mob; a seditious commotion; a popular tumult or riot.

EMICTION, n. ē-mīk'shūn [L. *e*, out of; *mictus*, made water]: the discharging of urine; what is voided by the urinary passages.

EMIGRATE—EMIGRATION.

EMIGRATE, v. *ěm'i-grāt* [L. *emigrātus*, removed or departed from a place—from *e*, out of; *migrō*, I wander: It. *emigrare*; F. *émigrer*]: to leave one's native country to reside permanently in another. **EM'IGRATING**, imp. **EM'IGRATED**, pp. **EM'IGRANT**, n. [F.—L.]: one who emigrates. **EM'IGRA'TION**, n. *-i-grā'shūn* [F.—L.]: removal to dwell or settle in another country.

EMIGRA'TION: passing from one part of the world to another for the purpose of permanent settlement. People going thus from one district of the same state to another—especially if it be a distant part, with different habits and physical peculiarities—are sometimes said to emigrate, and in this way the term has been often applied to the English and Scotch settlers in Ireland. In its established signification, however, the word now refers to those who leave the state or dominions in which they have heretofore lived, and in this sense the term applies to those going from Britain to the British colonies, though these also are under the British crown. In the country which people leave, they are called emigrants or wanderers out—in that in which they settle, they are usually called immigrants. Jacob and his family were immigrants to Egypt, and their descendants became emigrants from that country when they went to inherit the promised land.

The Greeks were addicted to E., owing, it has been said, to the many political contests which drove the weaker party from home. Greek emigrants planted colonies on the borders of the Mediterranean and the Black Sea, carrying them as far n. as France, where they established the city of Marseille. The Romans were great colonizers, but by conquest rather than E. They disliked leaving Italy; and the military and civil officers necessary to rule a colony were generally the only Romans who abode in it. These even did not, in general, settle in the colonies with their families, but were recalled after a certain period of service, the whole arrangement much resembling that for the government of British India.

The migrations of the northern tribes who overran the Roman empire, are well known in history; their wanderings may be said, indeed, to have continued till the 13th c. Those who wandered from the n. into France, where they acquired great territories, became known as Normans, and were remarkable for entirely throwing off the language and manners, and even all the traditions of their original homes, and becoming the most civilized and courtly portion of the French people. But though thus changed, they continued to wander, spreading over Britain, Sicily, and intervening portions of Europe.

The discovery of America opened a vast new field for emigration, which was immediately entered by the Spanish and Portuguese; and later, by the British, French, Germans, and Dutch. In the 17th c., many of the English Puritans, persecuted in, or discontented with, their own country, found it desirable, or thought it duty, to establish themselves in a new country where they could give their principles free development; and these pilgrims founded the

EMIGRATION.

New England colonies. In the 19th c., the plan of emigrating for the purpose of maintaining an exclusive church, seems to be revived in the English High Church colony of Canterbury, and the Scotch Free Church colony of Otago.

The great E. fields at the present day are the United States, and the British colonies in Australia, New Zealand, and s. Africa. The Dominion of Canada, especially in its vast western regions, attracts many settlers. There is a great distinction between colonies fit for E. and those dependencies of the British crown held for other purposes. India, for instance, the greatest British dependency, is totally unsuited for emigration. The British people who go there, with the exception of a few merchants, go to form the civil and military staff which rules the country. They stay there no longer than they can avoid, and instead of living on from generation to generation, send home their children in early youth, families of British origin having a tendency to degenerate, both physically and mentally, by long residence there. It is useless for working-people to go there, as every kind of work is done in some way or other by the natives much cheaper than it could be by Europeans, and the same may be said of every colony in the hot latitudes.

As a question in political economy, opinions about E. have oscillated violently. At one time it has been prohibited, at another encouraged by all kinds of tempting offers held out to emigrants, while teachers of political economy have proclaimed that there can never be too much E. The conclusion to which we are coming in this, as in so many other questions in political economy is, that what is good for the individual members of a community is good for the community collectively—if people can improve their condition by emigrating, it is well that they should emigrate; otherwise, it is better for the community that they stay at home. It might seem unnecessary to promulgate a doctrine which every man's self-interest should teach him, but unfortunately E. is one of the matters on which the populace have been liable to mischievous delusions. Sometimes poor workmen have crowded in where labor was super-abundant and capital deficient; at others, men have taken their capital to districts where there was no employment for it, and the unnaturally high price of the necessaries of life has immediately absorbed it all. Young gentlemen, with nothing but showy accomplishments, have gone to the backwoods of America, where they could prosper only by ceaseless toil in felling and clearing. Ambitious, discontented artisans have wandered to the wide pastures of Australia, where they could get a scanty subsistence only as hut-keepers or assistant shepherds, not having skill enough to be intrusted with the charge of stock.

The standard difficulty is the want of adjustment of capital to labor. This is enhanced by the circumstance, that those who wish to emigrate are generally persons feeling the pressure of poverty at home. The man, however, who goes to a place where there is no capital to employ him with—either his own or some other person's—is just in the pos-

ÉMIGRÉS.

ition of a shipwrecked marine cast on a desert shore. Government interference has been found necessary for protection of emigrants. The intending emigrant, before he leaves his own country, can, through means of agents, not only be shipped for a distant port, but can contract for his removal inland to his final place of settlement, and can even contract for the purchase of a plot of ground, and sometimes for the sale of his labor. The temptations and the opportunities for imposition in contracts to be fulfilled so far away from the place where they are undertaken, have caused the Brit. govt. and U. S. govt. to co-operate for the protection of emigrants to this country.—For statistics see IMMIGRATION.

ÉMIGRÉS, *ā-mē-grū* [Fr.]: name given especially to those persons who quitted France during the Revolution. After the insurrection at Paris, and the taking of the Bastille, 1789, July 14, the princees of the royal family departed from France. They were followed, after the adoption of the constitution of 1791, by all who considered themselves aggrieved by the destruction of their privileges, or who were exposed to persecution. Nobles quitted their châteaus; officers, with whole companies, passed the frontiers. Crowds of priests and monks fled to escape the oath of allegiance to the constitution. Belgium, Piedmont, Holland, Switzerland, and, above all, Germany, were overrun with fugitives of every age. Only a few had been able to save their property; the greater portion were in destitution, and sank into utter demoralization. A court had formed itself round the princes at Coblenz; a government, with ministers and a court of justice, had been established, and communication was kept up with all the foreign courts unfavorable to the Revolution. This conduct imbibed France, aggravated the position of the king, and drove the revolutionary party forward in their sanguinary career. Under the command of the Prince of Condé, a body of the émigrés was formed, which followed the Prussian army into Champagne. The result was that the severest laws were now put in force against the émigrés. Their lands were confiscated. The penalty of death was proclaimed against any one who should support or enter into communication with them. 30,000 persons were placed upon the list of émigrés, and exiled forever from the soil of France, though many of them had refused to bear arms against their country. Not until after the failure of their attempt to land at Quiberon, 1795, did the émigrés abandon all thoughts of penetrating into France by force of arms. Condé's corps, after the peace of Luneville, was obliged formally to dissolve, and sought asylum in Russia. Even under the Directory, however, many had endeavored to obtain permission to return to France. The general amnesty proclaimed by the First Consul was therefore joyfully hailed by the greater portion of the émigrés. Many, however, did not return home till after the downfall of Napoleon. Dignities, pensions, and offices were now showered upon these faithful adherents; but, according to the charter of 1814, they were unable to

EMILIAN PROVINCES—EMINENT DOMAIN.

recover either their estates or their privileges. Finally, on the motion of the minister Villèle, the émigrés who had lost their landed estates, by the law of 1825, Apr. 27, received a compensation of 30 million francs yearly on the capital of 1,000 million francs. After the July revolution, however, the grant was withdrawn. Compare Antoine de Saint-Gervais, *Histoire des Émigrés Français* (3 vols. Paris 1823), and Montrol, *Histoire de l'Émigration* (2d edit. Paris 1825).

EMILIAN, *ē-mīl'i-an* (or *ÆMILIAN*, *ē-mīl'i-an*) PROVINCES: portion of the recently formed kingdom of Italy, comprising the n. part of the States of the Church (the Romagna), and the duchies of Parma and Modena. The name is derived from the ancient Roman *Via Emilia* (a continuation of the *Via Flaminia*, or great n. road), which passed through these territories. The E. P. were formally annexed to Sardinia 1860, Apr. See ITALY.

EMINENT, a. *ēm'i-nēnt* [F. *éminent*—from L. *eminēn-tēm*, standing out, distinguished—from *e*, out of; *minēō*, I jut or project: It. *eminente*]: celebrated or conspicuous; rising above others; high in rank, etc.; dignified. EMINENCE, *-nēns* [F.—L.]: elevation; height; summit; highest part; high rank; distinction; a hill; title given by Pope Urban VIII., to cardinals in R. Cath. Chh., who had previously been called Most Illustrious and Most Reverend. EMINENTLY, ad *-tī*, in a high degree. EMINENTIAL, a. *-nēn'tshal*, in alg., term applied to an artificial kind of equation, which contains another eminently.—SYN. of ‘eminent’: illustrious; distinguished; prominent; lofty; elevated; exalted; remarkable; conspicuous; celebrated; famous; high; lofty.

EMINENT DOMAIN: power of the state to take private property for public use. It cannot, however, be exercised without making compensation to the party whose property has been taken. The right of E. D. is an attribute of sovereignty and exists in the American states, even independently of constitutions or statutes. It is to be distinguished from the taking of property by virtue of a war power, or of overruling necessity, or as a condemnation on the ground that the property taken was a nuisance, or in the exercise of police power, or as a forfeiture for the violation of law. In the last named cases, compensation need not be made to the owners. To make the use a public one, it is not necessary that the entire public should share in, or be benefited by a proposed improvement. If a considerable number of the people are interested therein the use is deemed sufficiently public provided it affects a matter concerning the entire community. The exercise of the power of E. D. may be, and usually is, delegated by the state to municipal corporations such as cities, towns, and villages, and to private corporations such as railroads and the like. General laws are provided under which the corporations must act in such cases. An owner of lands sought to be taken, cannot be forced to accept anything except money in payment of damages. But benefits conferred upon his remaining

EMİN PASHA—EMİR.

lands by the contemplated improvement may be deducted from the compensation for the land actually taken.

EMIN PASHA (EDWARD SCHNITZER): 1840, Mar.—1893, Feb. 26 (presumably); b. Oppeln, Prussia; explorer. He studied medicine at Berlin, was appointed a surgeon in the Turkish army 1868, and on being sent to Egypt became surg.gen. of the army under Gen. 'Chinese' Gordon. In 1878 he was raised to the post of gov.gen. of the Equatorial Provinces in Africa, with the title of 'Bey.' He reached the seat of his govt. the same year, and found the country in a deplorable condition; but he set to work earnestly, and in the space of three years swept all the slave-traders out of his enormous tract of land, with its 6,000,000 inhabitants. The provinces, which had been governed at an annual expense of \$200,000 prior to 1878, were able to send a surplus of \$40,000 to the Egyptian govt. 1882, after paying all expenses beside the cost of large public works. On the abandonment of the Soudan by England, E. was left to take care of himself in a territory where slave-traders were all-powerful. In 1882 he was cut off from all communication with the world, chiefly through the hostility of the king of Uganda, and 1886 he appealed for help through Dr. William Junker, Russian explorer. A relief expedition was organized by two wealthy Scotchmen who subscribed \$100,000; King Leopold of Belgium summoned Henry M. Stanley from a lecturing tour in the United States to take command; the expedition started 1887, Jan.; and 1888, Apr. 29, Stanley and E. met. E. was strongly opposed to leaving his people, and Stanley waited nearly a year for him to decide whether he would stay in Africa or accompany the relief party to Egypt. 1889, May 8, Stanley and E. started for the coast, and Dec. 4 reached Bagamoyo. In 1890, Apr., E. entered the German service to resume work in Africa. He was murdered by Arabs between Unyoro and Wadelai.

EMİR, n. *ē'mēr* [Ar. *amīr*: a commander: Heb. *amar*]: title given in the East, and in n. Africa, to all independent chieftains, also to all the actual or supposed descendants of Mohammed through his daughter Fatima. The latter are very numerous throughout the Turkish dominions, but though entitled by birth to be classed among the first four orders of society, they have no particular privileges or consideration; on the contrary, they are found engaged in all sorts of occupations, and are to be met with among beggars and the lowest of the populace, as frequently as among the mollahs. Their privileges are confined to a few unimportant matters, chiefly to the exclusive right to wear turbans of a green color, that having been the favorite color of the prophet. They are placed under the supervision of the Emir Beshir. In former times, the title of Emir was borne by the leaders in the religious wars of the Mohammedans, as well as by several ruling families, such as the Thaherides and Samanides in Persia, the Tulunides in Egypt, the first seven Ommaiades in Spain. The title Emir, in connection with other words, likewise

EMISSARY—EMMANUEL COLLEGE.

designates different offices. *Emir-al-Mumenin*, ‘Prince of the Faithful,’ is the title assumed by the caliphs themselves. *Emir-al-Muslemin*, signifying the same, was the title of the Almoravides. *Emir-al-Omrah*, ‘Prince of Princes,’ was the title of the first minister, under the caliphs and the E. Indian Moguls, who united in his own person the highest civil and military dignities. It is now the title of the governors of different provinces. The Turkish master of the horse is styled *Emir-Achor*; the standard-bearer, *Emir-Alem*; and the leader of the caravans of pilgrims to Mecca, *Emir-Hadji*. *Ameer* or *Amere* is another spelling of the same word.

EMISSARY, n. *ěm'is-sér-ě* [L. *emissāriūs*, an emissary, a spy—from *e*, out of; *missus*, sent: It. *emissario*: F. *émissaire*]: a spy; a secret agent; one sent on private messages.

EMISSION: see under **EMIT**.

EMIT, v. *ě-mít'* [L. *emittērē*, to send out or forth—from *e*, out of; *mitto*, I send: F. *émettre*]: to send forth; to throw or give out; to let fly. **EMITTING**, imp. **EMITED**, pp. **EMISSION**, n. *ě-mísh'ún* [L. *e*; *missus*, sent]: the act of sending out; an issuing out; that which is issued.

EMLY, *ěm'lí*: an Irish see, united to Cashel 1568.

EMMANUEL, or **EMANUEL**, *ěm'-ăñ'ū-ěl*, or **IMMANUEL**, *im'-ăñ'ū-ěl*: Hebrew name employed by the prophet Isaiah, the signification of which—‘God with us’—is not by itself proof that the child to whom it was to be given would be divine. But in Matt. i. 23, it is declared that the name had been divinely applied in a special prophetic manner to the child Jesus. The prophecy itself (Is.vii. 14) calls for a fulfilment near at hand, and in accordance with the ordinary laws of nature; the mother of the promised child being unmarried at the time the prophet spake. The birth of such a child in fulfilment of a special promise might be a sufficient sign for a deliverance from national calamity. But as the whole prophecy of Isaiah has supreme reference to a spiritual salvation, the sign of the lower deliverance may have also an ultimate application to the higher; a woman unmarried pointing forward to the virgin mother, and a common child taken as a prophetic emblem of the child Jesus miraculously conceived and born. That this is the true interpretation is argued from (1) the New Testament account of the nativity, the inspired authority of which is established by independent evidence; (2) by the Scripture exhibition of the character and works of Jesus in attestation of His claim to be the Deliverer and Savior who had been prophesied as to be sent forth from God.

EMMANUEL COLLEGE, CAMBRIDGE, England: founded 1584 by Sir Walter Mildmay, chancellor of the exchequer and privy-councilor in the reign of Queen Elizabeth. The foundation fellowships number 13. These are open to all her majesty’s subjects, and a candidate

EMMENAGOGUE—EMMET.

becomes eligible to them on proceeding to the degree B.A. or any equivalent degree. All the foundation fellows are obliged to proceed regularly to the further degree in art, law, medicine, or any other faculty that they have selected. There must be four of them always in priest's orders; and any who are not tutors or bursars in the college, are bound to be in orders at the end of the seventh year of their fellowship, at the risk of forfeiting it three years afterward. The college possesses also two fellowships and four scholarships on Sir Wolstan Dixie's foundation (but the Dixie fellows have no voice in college affairs, nor any claim to the offices or dividends of the college); 21 scholarships (13 of £70 a year, 5 of £30, and 3 minors of £70), paid from the general revenues of the college; five of £30 a year, founded by Dr. Thorpe; and other seven (4 of £35, 2 of £50, and 1 of £16), for which candidates from certain schools have a preferable claim. The patronage of the college consists of 24 benefices, situated in the e. and s.w. counties of England; and of two schools, one in Norfolk, the other in Suffolk. This college had (1881) 369 members of senate, 81 undergraduates, and 484 members on the boards.

EMMENAGOGUE, n. *ěm-měn'ă-gög* [Gr. *emmēniā*, the menses; *ago*, I lead]: medicine which promotes the menstrual discharge—restoring it or bringing it on for the first time. The emmenagogues chiefly in use are preparations of aloes, iron, myrrh, and other stimulants in connection with purgatives; also the local use of the warm bath, leeches, fomentation, etc. Some recommend still more powerful and direct applications to the uterine mucous membrane; as galvanic pessaries, lunar caustic, scarifications, etc.; but these are not in general use. SEE MENSTRUATION.

EMMERICH, *ěm'mér-ich*: town of Rhenish Prussia, on the right bank of the Rhine, on the borders of Holland. It is very old, and has a Dutch character of cleanliness. It has a custom-house, an orphan-house, a gymnasium, and several churches. E. has manufactures of tobacco, chocolate, leather, and liqueurs. Pop. (1880) 8,900; (1890) 9,622

EMMET, n. *ěm'mět* [AS. *æmet*, an emmet—from *æmetta*, leisure, rest: Ger. *ameise*, an emmet—from *emsig*, assiduous diligent]: an ant: see ANT. -

EMMET, *ěm'ět*, ROBERT: 1778–1803, Sep. 20; b. Dublin (some authorities state his birth 1780, Cork): Irish patriot and orator. He was a school-fellow of Thomas Moore, the poet, in Trinity College, from which he was expelled for avowing republican principles 1798, and then joined the assoc. of United Irishmen, who undertook to separate Ireland from Great Britain and establish an independent republic. He became a leader in this movement, and on its failure went to France and planned a general uprising of the Irish people. In 1802 he returned to Dublin, organized his forces, established depots of powder and firearms, and designated 1803, July 23, as the time for seizing the castle and arsenal. On that day the insurgents

EMMET—EMMONS.

killed the chief-justice, Lord Kilwarden, and fled at the first volley from the garrison. E. left the city, but returning to bid his betrothed adieu, was arrested, tried, and condemned, and the sentence of death was executed. He defended himself in a speech of remarkable eloquence.

EMMET, THOMAS ADDIS, LL.D.: Irish patriot and lawyer: 1764, Apr. 24—1827, Nov. 14; b. Cork: brother of Robert E. He graduated at Trinity College, Dublin, took a medical course in Edinburgh Univ., and his degree 1784, studied law in the Temple, London, and was admitted to the bar in Dublin 1791. In 1798 he was an active member of the assoc. of United Irishmen, was arrested with many associates, and confined in prison nearly 3 years. He was liberated after the treaty of Amiens, but exiled from Ireland. In 1802-3 he lived in Brussels, 1804 came to the United States, and on the advice of Gov. Clinton settled in New York, where he practiced law with signal ability and success, and 1813 became atty.gen. of the state. He published *Pieces of Irish History*, written while in prison in Scotland (New York 1807).

EM'MITSBURG, or EM'METSBURG: village of Frederic co., Md.; 1 m. from Mason and Dixon's Line, 8 m. n. of Mechanicstown, 10 m. s.s.w. of Gettysburg, 50 m. w.n.w. of Baltimore. It contains 5 churches, 2 hotels, 1 private bank, and manufactories of furniture and machinery; and is widely known as the seat of Mount St. Mary's (Rom. Cath.) College, founded 1809; of St. Joseph's (Rom. Cath.) Acad., founded 1810; and of the mother-house of the Rom. Cath. Sisters of Charity in the United States. E. was founded by William Emmitt abt. 1773. Pop. (1870) 706; (1880) 847; (1890) 844; (1900) 849.

EMMONS, ēm'onz, GEORGE FOSTER: 1811, Aug. 23—1884, July 2; b. Clarendon, Vt.: naval officer. He entered the U. S. navy as midshipman 1828, became passed midshipman 1831, was commissioned lieut. 1841, commander 1856, capt. 1863, commodore 1868, and rear-admiral 1872, and was retired 1873, Aug. 23. He was attached to Capt. Wilkes's South Sea exploring expedition 1838-42, served on the w. coast of Mexico and in Cal. during the Mexican war, captured Cedar Keys, Fla., and Pass Christian, Miss., with 20 prizes 1862, was fleet-capt. under Dahlgren off Charleston 1863, commanded a division of blockading vessels in the Gulf of Mexico 1864-5, and raised the American flag over Alaska 1868.

EMMONS, NATHANAEL, D.D.: 1745, May 2—1840, Sep. 23; b. East Haddam, Conn.: Congl. minister and theologian. At the age of 18 he entered Yale College, and was one of the four best scholars of his class. Having chosen the study of theology, he was well instructed in the views of Bellamy and of the elder Edwards by one of his teachers, Dr. John Smalley of Berlin, Conn. In 1773 he became pastor of the Congl. church in Franklin, Mass., in which office he continued 54 years. He preached about 6,000 sermons, many of which were published; and now, together with some of his other writings, fill six large octavo volumes. He fur-

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nished also more than 200 articles to various magazines; and directed the theological studies of about 100 young men, many of whom became distinguished as ministers, teachers, professors, and presidents in literary and theological institutions. In these various labors he was accustomed to spend from 10 to 14 hours daily for more than 70 years. His mind was sprightly yet reverent; his style of thought was original, independent, and clear. Dr. Leonard Woods of Andover said of him, 'He has one of the grandest understandings ever created.' When the Masonic order was most popular he opposed it; when anti-slavery was most unpopular he upheld it. In politics he was a bold federalist. He retained his faculties in a surprising degree; and, enjoying the esteem of all who knew him, died with an unfaltering Christian faith, in the 68th year of his ministry, and the 96th of his age. His theological system is often confounded with that of Dr. Samuel Hopkins; but the following statement (furnished by Dr. Emmons himself) of the two systems, as he regarded them, shows the difference as well as the agreement between them. '*I. The distinctive tenets of Hopkins's system are:* 1. All real holiness consists in disinterested benevolence; 2. All sin consists in selfishness; 3. There are no promises of regenerating grace made to the doings of the unregenerate; 4. The impotency of sinners with respect to believing in Christ is not natural, but moral; 5. A sinner is required to approve in his heart of the divine conduct, even though it should cast him off forever; 6. God has exerted His power in such a manner as He purposed would be followed by the existence of sin; 7. The introduction of moral evil into the universe is so overruled by God as to promote the general good; 8. Repentance is before faith in Christ; 9. Though men became sinners by Adam, according to a divine constitution, yet they have, and are accountable for, no sins but personal; 10. Though believers are justified by Christ's righteousness, yet his righteousness is not transferred to them. *II. The distinctive tenets of Emmons's system are:* 1. Holiness and sin consist in free, voluntary exercises; 2. Men act freely under the divine agency; 3. The least transgression of the divine law deserves eternal punishment; 4. Right and wrong are founded in the nature of things; 5. God exercises mere grace in pardoning or justifying penitent believers through the atonement of Christ, and mere goodness in rewarding them for their good works; 6. Notwithstanding the total depravity of sinners, God has a right to require them to turn from sin to holiness; 7. Preachers of the gospel ought to exhort sinners to love God, repent of sin, and believe in Christ immediately; 8. Men are active, not passive, in regeneration.'

Dr. Emmons believed that these 8 propositions are involved in the system of Dr. Hopkins; that they are *evolved from it*, rather than *added to it*. Still they characterize Emmonism as it is grafted upon Hopkinsianism. (Prof. Edwards A. Park, *Schaff-Herzog Encyc.*)

EMOLLIATE—EMORY.

EMOLLIATE, v. *ē mōl'ē-āt* [L. *emollitus*, made soft—from *e*, out of; *mollīō* I soften]: to soften. **EMOLLIATING**, imp. **EMOLLIATED**, pp. **EMOLlient**, a. *-ēnt* [F.—L.]: softening; that which softens or makes supple: N. substance which relaxes or softens; applied in medicine externally, as poultices, fomentations, etc., and internally as denulcents (q.v.). **EMOLLITION**, n. *ēm'ō-lish'ūn*, the act of softening or relaxing. **EMOLLESSENCE**, n. *-lēs'sēns*, that degree of softening produced in a body when its shape begins to alter.

EMOLUMENT, n. *ē-mōl'ū-mēnt* [OF. *emoulment*—from L. *emolūmēntum*, a working out, labor—from *e*, out of; *mōlīrī*, to exert one's self]: profit from an office; advantage; profit; gain. **EMOLUMENTAL**, a. *-mēn'tāl*, useful; yielding profit.

EMORY, *ēm'o-rī*, JOHN, D.D.: 1789, Apr 11—1835, Dec. 17; b. Queen Anne co., Md.: Meth. Episc. bp. He received a collegiate education, studied law and was admitted to the bar 1808, and entered the ministry of the Meth. Episc. Church 1810. With one exception he was a delegate to every general conference of his church between 1816 and 1832, and during this period he represented American Methodism in the British Wesleyan conference 1820, and was appointed book agent and editor in New York 1824. He founded the *Methodist Quarterly Review*, and actively promoted the establishment of the Univ. of New York, Wesleyan Univ., and Dickinson College. He was elected bp. 1832, and beside controversial papers of note, 1817, 28, was author of *The Divinity of Christ Vindicated*, and *Defense of Our Fathers*.

EMORY, *ēm'o-rī*, WILLIAM HEMSLEY: 1811, Sep. 9—1887, Dec. 1; b. Queen Anne co., Md.: soldier. He graduated at the U. S. Milit. Acad. 1831, and was appointed lieut. of artil. and mounted rangers; was appointed 1st lieut. topographical engineers 1838; promoted capt. and brev-maj. 1847; lieut.col. 6th U. S. cav. 1861; brig.gen. vols. 1862; brev.maj.gen. vols. 1864; brev.brig.gen. and brev.maj.gen. U.S.A. 1865; full maj.gen. of vols. 1865, Sep.; and retired as brig.gen. U.S.A. 1876. He was on duty in Charleston harbor during the nullification troubles; was employed on the Del. river improvements and the n.w. boundary survey; was on Gen. Kearny's staff during the Mexican war; ran the boundary between Mexico and the United States under the Gadsden treaty; served with marked distinction through the civil war; and commanded the dept. of W. Va. 1865-66; of Washington 1869-71, and of the Gulf 1871-75.

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EMOTION, n. *ĕ-mō'shūn* [F. *émotion*—from L. *emōtiōnem*, a moving out or forth—from *e*, out of; *mōvēō*, I move]: disturbance or agitation of the mind; vehemence of passion; excitement. EMOTIONAL. a. pertaining to emotion.—SYN. of ‘emotion’; agitation; trepidation; tremor; feeling; perturbation.—*Emotion*, in mental philosophy, is one of the comprehensive departments of the human mind. It is now usual to make a threefold division of the mind—Emotion, or Feeling; Volition, or Action prompted by Feelings; and Intellect, or Thought. It is not meant that these can be manifested in absolute separation; or that we can be at one time all emotion, another time all volition, and again all thought, without either of the other two. But though our living mind is usually a concurrence, in greater or less degree, of all of them, still they can be distinguished as presenting different appearances, according as one or other predominates. Wonder, Anger, Fear, Affection, are emotions; the Acts that we perform to procure pleasurable feelings, and avoid painful, are volitions, or exercises of Will; Memory and Reasoning are processes of Thought, or Intellect.

Emotion is essentially a condition of the waking, conscious mind. When in dreamless sleep, or in a faint, or in any of those states called ‘being unconscious,’ we have no emotion; to say that we have would be a contradiction, which shows that ‘emotion’ is a very wide and comprehensive word. In fact, whenever we are mentally excited in any way, we may be said to be under emotion. Our active movements and intellectual processes can sometimes go on with very little consciousness; we may walk and scarcely be aware of it; trains of thought may be proved to have passed through the mind while we are unconscious of them. Now, it is these unconscious modes of Volition and Intellect that present the greatest contrast to emotion; showing how nearly co-extensive this word is with mental wakefulness, or consciousness, in its widest signification.

Emotion, then, is of the very essence of mind, though not expressing the whole of mind. There are three distinct kinds or divisions of it: Pleasures, Pains, and Excitement that is neither pleasurable nor painful.

Every kind of Pleasure is included under emotion in its widest acceptation. The pleasures of the senses are as much emotional as those pleasures that are not of the senses—as, for example, those of Power, Pride, Affection, Malevolence, Knowledge, Fine Art, etc. Every one of our senses may be made to yield pleasurable emotion; and all those other susceptibilities, sometimes called the special emotions, of which a classification is given below, are connected with our pleasures or our pains. What pleasure is in its inmost nature, each one must find from his own experience; it is an ultimate fact of the human consciousness which cannot be resolved into anything more fundamental, though, as will be seen, we can lay down the laws that connect it with the other manifestations of mind—namely, action and thought, and with the facts of our corporeal life.

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In the next place, Pain is a species of emotion. We know this condition as being the opposite of Pleasure, as the source of activity directed to its removal or abatement, and as the cause of a peculiar outward appearance, known as the Expression or Physiognomy of Pain. All the inlets of pleasure are inlets also of pain. The various sensibilities of the mind, whether the outward senses, or the more inward emotions, give rise at one time to pleasure, at other times to pain, the conditions of each being generally well understood by us; we can define the agencies that cause pleasure or suffering through the skin, the ear, or the eye.

But it is requisite, further, to recognize certain modes of Neutral Excitement, in order to exhaust the compass of emotion. We are very often roused, shocked, excited, or made mentally alive, when we can hardly say that we are either pleased or put to pain. The mind is awakened and engrossed with some one thing, other things are excluded; and the particular cause of the excitement is impressed upon us so as to be afterward remembered, while all the time we are removed alike from enjoyment and from suffering. There is a kind of emotion that has its principal value in the sphere of intellect. The emotion of Wonder or Astonishment is not seldom of this nature; for though we sometimes derive pleasure, and sometimes pain, from a shock of surprise, we are very frequently affected in neither way, being simply *impressed*. The strange appearance of a comet gives far more of this neutral effect than of the others. It is a thing that possesses our mind at the time, and is afterward vividly remembered by us, and these are the chief consequences of its having roused our wonder.

The Physical Accompaniments of emotion are a part of its nature. It has been remarked in all ages, that every strong passion has a certain outward expression or embodiment, the token of its presence to the beholder. The child soon learns to interpret the signs of feeling. Joy, Grief, Affection, Fear, Rage, Wonder, have each a characteristic expression; and painters, sculptors, and poets, have adopted the demeanor of passion as a subject for their art. There must be some deep connection in the human frame between the inward states of consciousness, and the physical or corporeal activities, to produce results so uniform throughout the human race. When we study the facts closely, we obtain decisive proof of the concurrence of the following members and organs in the manifestation of feeling.

In the first place, the *muscles* or *moving organs* are affected. Under strong excitement, the whole body is animated to gesticulation; in less powerful feelings, the expression confines itself more to the *features* or the movements of the face. These last have been analyzed by Sir Charles Bell. The face has three centres of movement—the Mouth, Eyes, and Nose; the mouth being most susceptible, and therefore the most expressive feature. In the eyes, expression is constituted by the two opposite movements of the eyebrows; the one raising and arching them (prompted by a

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muscle of the scalp, *occipito-frontalis*), the other corrugating and wrinkling them. The one movement is associated with pleasing states, the other with painful. The Nose is acted on by several muscles, the most considerable of which is one that raises the wing together with the upper lip, and is brought into play under the disgust of a bad smell and in expressing dislike generally. The Mouth is principally made up of one ring-like muscle (*orbicularis*), from which nine pairs radiate to the cheeks and face. In pleasing emotions, the mouth is drawn out by the action of two pairs of muscles, named the buccinator and zygomatic, situated in the cheek. The expression of pain is determined by the contraction of the aperture of the mouth, through the relaxation of those muscles, and the contraction of the ring-like muscle that constitutes the flesh of the lips; and by two muscles in the chin, one depressing the angle of the mouth, and the other raising the middle of the lower lip, as in pouting. Besides the features, the Voice is instinctively affected under strong feelings; the shouts of hilarious excitement, the cry of sharp pain, and the moan of protracted agony, are universally known. Another important muscle of expression is the Diaphragm, or midriff, a large muscle dividing the chest from the abdomen, and regularly operating in expiration. In laughter, this muscle is affected to convulsion.

In the second place, the *organic functions* of the system are decidedly influenced for good or evil under emotion. The glandular and other organs acted on in this way comprehend the most important viscera of the body. The Lachrymal Secretion is specifically affected under passion; the flow of tears being accelerated to a rush, instead of pursuing the tranquil course of keeping the eyeball moist and clean. The states of the Sexual Organs are connected with the strongest feelings of the mind, being both the cause and the effect of mental excitement. The Digestion is greatly subject to the feelings, being promoted by joy and hilarity not in excess, and arrested and disturbed under pain, grief, terror, anger, and intense bodily or mental occupation. The Skin is known to respond to the condition of the mind; the cold sweat in fear is a derangement of its healthful functions. The Respiration may be quickened or depressed according to the feelings. The action of the Heart and the Circulation of the Blood are subject to the same causes. For the nature of this influence, see BLUSHING. Lastly, in women, the Lacteal Secretion participates in the states of emotion, being abundant, healthful, and a source of pleasure in a tranquil condition of mind, while grief and strong passions change it to a deleterious quality.

The connection between mental emotion and bodily states being thus a fact confirmed by the universal experience of mankind, can we explain this connection upon any general law or principle of the human constitution? Have we any clue to the mysterious selection of some actions as expressing pleasure, and others as expressing pain? The reply is, that there is one principle or clue that unravels

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much of the complexity of this subject—namely, that *states of pleasure are usually accompanied with an increase in some or all of the vital functions, and states of pain with a depression or weakening of vital functions.* This position may be maintained on a very wide induction of facts, many of them generally recognized, others open to any careful observer; there being, however, some appearances of an opposite kind, which have to be satisfactorily accounted for, before we can consider it established.

If we consider first the respective *agents* or causes of pleasure and pain, we must acknowledge that they are generally of a nature to accord with the view now stated. How many of the sources of pleasure are obviously sources of increased energy of some vital organs. The case of Food is too obvious to need any comment. Warmth within limits both confers pleasure and stimulates the skin, the digestion, and other functions. Fresh air exhilarates the mind, while quickening the respiratory function. Light is believed to stimulate the vital actions no less than the mental tone. And if there be some pleasures of sense, such as mere sweetness of taste, fragrant odors, music, etc., that do not obviously involve greater energy of vital function, they might be seen to do so, if we knew more than we do respecting the operation of the various organs, and we are certain that they do not have the opposite effect. Medical authorities are so much impressed with the general tendency of pleasures, that they include them in the list of *stimulants* in cases of low vitality. If we pass from the senses to the special emotions, such as Wonder, Power, Tender Affection, Taste, we find that when those are pleasing, they also increase the animal forces at some point or other. A stroke of victory sends a thrill through the whole system; and if the pulse were examined at that moment, we should find that it beats stronger. The illustration for Pains is exactly parallel, but still more striking. It is notorious that hurts, wounds, fatigue, ill-health, hunger, chillness, nauseous tastes and odors, the silence of a prison, the gloom of utter darkness, failure, humiliation, contumely, deprivation of one's usual comforts and pleasures—while causing pain, cause in a corresponding degree a depression of the powers of the system. There are some apparent exceptions, as in the stimulus of the whip, the bracing agency of cold, and the effect of misery generally in rousing men from lethargy to action, but these could all be shown to be quite-compatible with the main principle.

If we turn from the agents to the *expression*, or modes of manifestation, of the opposing mental conditions, we shall find that the facts are of the same general tenor, though with some seeming exceptions. Joy makes a man spontaneously active, erect, animated, and energetic. It is as if a flush of power were diffused through his members; and the efforts to which he is then prompted, lead to no painful exhaustion. The opening of the features, by the elevation of the eyebrows and the retraction of the mouth, indicates that the stream of energy has coursed over the face. In a still greater shock, the convulsiveness of

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taught, by which respiration is quickened, attests the superabundance of the animal spirits. The body stands more erect, and every act done is done with more emphasis. Grief and depression are the opposite in every particular. The frame is languid and stooping, the features lifeless, the voice is a feeble wail; and though there is a species of convulsion attending on this condition of mind, it is a marked contrast to the other. The sob is caused by the *partial paralysis* of the diaphragm, which necessitates great voluntary efforts in order that breathing may proceed. The choking sensation at the throat is also a species of paralysis from loss of vital power. The convulsions arising under such circumstances are productive of an exhausting reaction, which is the case with all the energetic movements stimulated by extreme pain.

Such is undoubtedly the general fact. But why should pain stimulate, or give strength to, *some special* muscles, such as the corrugator of the eyebrow, and the depressor of the angle of the mouth? This has appeared a great difficulty to the ablest physiologists. It seems as if pleasure coincided with an energetic wave sent to some muscles, and pain with an energetic wave sent to others; so that the opposite conditions of mind are equally accompanied by an accession of power to some bodily member. But if we examine the matter narrowly, it will probably be found that the muscles that seem to be stimulated under pain, are not so in reality, but obtain the upper hand through the general relaxation of the system. For instance, take the mouth: we know its state in languor, inaction, and sleep. We know that when we are roused in any way, the muscles of the face operate and draw the mouth asunder in a variety of forms. Pleasure corresponds with our energetic moods, pain causes a collapse toward the sleepy and exhausted condition which represents a state of departed energy. So the collapse of the body might seem an exertion of the *flexor* muscles, or those that bend the frame forward; but we are well aware that such collapse takes place when the system is totally lifeless. A renewed energy, as a matter of course, makes us stand erect.

This, in reply to the objections arising from a specific expression of pain, is a part of the case, but not the whole; and the answer to the difficulties still remaining is furnished by a fact that, if well authenticated, will probably dispose of nearly all the exceptions to the general principle now contended for. It is the organic functions, *more than the muscular system*, whose increased vitality coincides with pleasurable feeling, and their diminished action with pain. Muscular exercise is often highly agreeable, but the pleasure of *resting* after exercise is still more so. Now, there can be little doubt that what happens in the state of healthful repose is this: the amount of vital force stimulated by exercise—the increased energy derived from plying the lungs and heart—is now allowed to leave the active members, and to pass to the other organs—the digestion, skin, and various secreting glands—and it is their aggrandizement that is associated with the comfortable sensations of repose.

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and sinking into sleep. Thus, the abating of muscular energy may be a cause of pleasure, provided the organic functions are raised in consequence; but it may be maintained as a highly probable supposition, that a certain health and energy of some or all of these functions (it is difficult to draw a specific line) is essential to pleasurable feeling. We may doubt whether even mental causes can materially raise the tone of enjoyment, if they do not raise also the activity of some of these organs. Not only may a person be happy and comfortable in the prostration of the muscular energy, even in a sick-bed, but one way of procuring comfort is to induce a total inaction of the moving members, to allow all the available nervous power to pass to the viscera and secretions. Hence a *forced relaxation* of the muscles *generally*, by the employment of *some* of them, is a means of soothing the mind under pain. Thus, the active intervention of certain small muscles—such as the corrugator of the eyebrows, the orbicular muscle of the mouth, and the depressor of the angle of the mouth—by relaxing a much greater body of muscle, is the means of setting free vital energy for behoof of the other parts of the system. This would explain the mental relief furnished by an assumed sadness of feature, and a voluntary collapse of the body generally.

It appears then, that the stimulus of muscle is not necessarily or immediately a cause of pleasure; while the stimulus of the organic functions is so. Thus, a bracing cold quickens the activities, but is apt to cause a shock of pain, by temporarily checking the action of the skin; when the reaction arrives, this check is converted into stimulation, and the mental state is altered in like manner. A bitter tonic must be supposed to act on the same principle.

The emotions of the human mind may be classified under two heads:

First—The pleasures, and pains, and modes of excitement growing out of the exercise of the Senses, the Movements, and the Appetites: see SENSES. The five senses, commonly recognized, are partly sources of pleasure and pain, in which case they yield Emotion, and partly sources of Knowledge, by which they are related to the Intellect. There are other sensibilities not included in the five senses, but ranking with them in those particulars—as the feelings of Muscular Exercise and Repose, and the sensations of Digestion, Respiration, etc.

The second head comprises the Special Emotions not arising immediately out of Sensation, though connected therewith. These have been variously classified. The following is one classification: 1. Feelings of Liberty and Restraint; 2. Wonder; 3. Terror; 4. Tender Affections; 5. Emotions of Self-complacency, Love of Approbation, etc.; 6. Sentiment of Power; 7. Irascibility; 8. Emotions of Action, including the interest of Pursuit or Plot; 9. Emotions of Intellect, Love of Knowledge, Consistency, and Inconsistency; 10. Fine Arts' Emotions, or Taste; 11. The Moral Sense.

On this subject see Müller's *Physiology, Movements due to the Passions of the Mind*; Bell's *Anatomy of Expression*;

EMPÆSTIC—EMPEDOCLES.

Stewart on the *Active Powers*; Bain on the *Emotions and the Will*, etc.—See WILL; and its References.

EMPÆSTIC, or EMPESTIC, a. *ěm-pěst'ik* [Gr. *empaistikē* (*technē*), the art of embossing--from *empaiō*, I stamp in—from *em* or *en*, in; *paiō*, I strike]: term applied to inlaid work, resembling the modern buhl or marquetry; next to Toreutic art (with which it must not be confounded), it was most practiced by the ancients. It consisted in knocking threads or pieces of different metals into another piece; also embossing.

EMPALE, v. *ěm-pál'* [F. *empaler*—from *em*, in or on; L. *pálus*, a pole or stake]: to put to death by driving a sharpened stake or pole through the body; to inclose or surround with poles. EMPALING, imp. EMPALED, pp. *-páld'*. EMPALE MENT, n. [F.—L.]: putting to death by thrusting a sharpened stake or pole through the body.

EMPAN'NEL, or IMPANNEL, or EMpanel: see IMPANEL
see also PANEL.

EMPECINADO, *ěm-pā-thē-ná Hō*, Don JUAN MARTIN DIAZ, EL: 1775–1825: one of the leaders of the Spanish revolution of 1820. He was the son of poor parents, and entered the Spanish army 1792. At the head of 5,000 or 6,000 men, he carried on a guerilla warfare against the French during the Peninsular struggle, and acquired great distinction. In 1814, he was appointed col. in the regular army, and the king himself created him field-marshall; but in consequence of petitioning Ferdinand, 1815, to reinstitute the Cortes, he was imprisoned, and afterward banished to Valladolid. On the outbreak of the insurrection 1820, he took a prominent part on the side of the constitutionalists, and on several occasions showed great courage, daring, and circumspection. After the triumph of the absolutists 1825, he was arrested, exposed in an iron cage to the contumely of the passers-by, and finally executed on a common gibbet, amid the ferocious yellings of a debased and liberty-hating populace.

EMPEDOCLES, *ěm-pěd'o-klēz*: Greek philosopher of Agrigentum, in Sicily; about B.C. 450. So great was the estimation in which he was held by his fellow-citizens as a physician, a friend of the gods, a predictor of futurity, and a sorcerer, or conjurer of nature, that they are said to have offered him the sovereignty. But being an enemy of tyranny, he declined it, and was the means of delivering the community from the dominion of the aristocracy, and bringing in a democracy. There was a tradition that he threw himself into the crater of Etna, in order that his sudden disappearance might beget a belief in his divine origin; this, however, is only a fable, like the story told by Lucian, that Etna in eruption threw out the sandals of the vain philosopher, and thus destroyed the popular belief in his divinity. The statement of Aristotle is, that he died at the age of 60; later writers of less weight extend the period of his life considerably further.

In E., philosophic thought is bound up with poetry and myth even in a higher degree than in Parmenides (q.v.). His general point of view is determined by the influence of

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the Eleatic school (q.v.) upon the physical theories of the Ionic philosophers. He assumed four primitive independent substances—air, water, fire, and earth, which he designates often by the mythical names Zeus, Hera, etc. These four *elements*, as they were called, kept their place till modern chemistry dislodged them: see ELEMENTS. Together with material elements, he affirmed the existence of two moving and operating powers, love and hate, or friendship and strife, the first as the uniting principle, the second as the separating. The contrast between matter and power, or force, is thus brought out more strongly by E. than by previous philosophers. The origin of the world, or cosmos, he conceived in this way: In the beginning, the elements were held in a sort of blended unity, or *sphere*, by the attractive force of love; when hate, previously exterior, penetrated as a repelling and separating principle. In this process of separation, which gives rise to the individual objects of nature, he seems to have assumed a series of stages, a gradual development of the perfect out of the imperfect, and a periodical return of things to the elemental state, in order to be again separated, and a new world of phenomena formed. From the fragments that we possess of his didactic poem, it is not clear how far he considered fire as the substratum of strife, and water as the substratum of love, and ascribed various creations to the predominance of one or the other of these principles. Of his opinions on special phenomena, may be mentioned his doctrine of emanations, which proceeding from one thing enter into corresponding openings in other things. By this assumption in connection with the maxim, that like is known only by like, he thought to explain the nature of perception by the senses. He attempted to give a moral application to the old doctrine of the transmigration of souls, his views of which resembled those of Pythagoras. The fragments of E. have been edited by Sturz (2 vols. Leip. 1805), Karsten (Amst. 1838), and Stein (Bonn 1852).

EMPEROR, n. *ém'pér-ér* [F. *empereur*; OF. *empereor*, an emperor—from L. *impérātōrem*, a commander—from *impérō*, I command: It. *imperatore*]: a sovereign; a title of dignity higher than a king. **EMPRESS**, n. *-pr̄es* [OF. *empereis*—from L. *imperātrīcem*]: consort or wife of an emperor.—The original signification of the word *emperor*, which in the modern world has become the highest title of sovereignty, can be understood only when it is taken in conjunction with *imperium*, which in the Roman political system had a peculiar and somewhat technical meaning. The imperium of a magistrate, be he king or consul, was the power which he possessed of bringing physical force into operation for the fulfilment of his behests. This power was conferred by a *lex curiata*, and it required this authorization to entitle a consul to act as the commander of an army. In the case of the kings also, the imperium was not implied in their election, but was conferred separately, by a separate act of the national will. ‘On the death of King Pompilius,’ says Cicero, ‘the *populus* in the *comitia curiata* elected Tullus Hostilius king, upon the rogation of an *interrex*; and the king, following the example of Pompilius, took the votes of the *populus*,

EMPEROR MOTH.

according to their *curiae*, on the question of his imperium.'—*Republic*, ii. 17. Now, it was in virtue of this imperium that the title imperator was given to its possessor. Far from being an emperor in the modern sense, he might be a consul or a pro-consul; and there were, in fact, many imperatores, even after the title had been assumed as a prenomen by Julius Cæsar. It was this assumption which gradually gave to the title its modern signification. In republican times, it had followed the name, and indicated simply that its possessor was *an* imperator, or one possessed of the imperium; now it preceded it, and signified that he who arrogated it to himself was *the* emperor. In this form it appears on the coins of the successors of Julius. After the times of the Antonines, the title grew into use as expressing the possessor of the sovereignty of the Roman world, in which sense *Princeps* also was frequently employed. In the introduction to the *Institutes*, Justinian, speaking of himself, uses both in the same paragraph. From the emperors of the West, the title passed to Charlemagne, founder of the German empire. When the Carlovingian family expired in the German branch, the imperial crown became elective, and continued to be so till it ceased—Francis II., who 1804 had declared himself hereditary Emperor of Austria, having laid it down 1806. In addition to the Emperor of Austria, there are now in Europe the Emperor of Russia, and German Emperor, the latter of whom, was, 1871, Jan. 18, proclaimed under this title within the Hall of Mirrors, in the palace of the French kings at Versailles, in the presence of the German princes, and the standards of the German army which was beleaguering Paris. In 1876 the Queen of England assumed the title Empress of India, in addition to those which she bore previously.

EMPEROR MOTH (*Saturnia pavonia minor*): moth of



Emperor Moth, with Caterpillar, Pupa, and Cocoon,

EMPETRACEÆ—EMPHYTEUSIS.

the same family (*Bombycidae*) with the silkworm moth. The E. M. is the largest British lepidopterous insect. Its expanse of wings is about three and a half inches. Each wing is ornamented with a large eye like glassy and transparent spot. The Peacock Moth (*S. pavonia major*) is the largest European species, and attains an expanse of 5 inches across the wings.

In the United States are similar large moths of this genus. *S. Io.*, female, expands $3\frac{1}{2}$ in.; the fore-wings are purple-brown; in the male, expanding $2\frac{3}{4}$ in., they are Indian yellow; both have on the hind wings a large blue ‘eye,’ black-bordered and white-centred. The young caterpillars march in ranks, first one, then two, then three, etc.

EMPETRA'CEÆ: see CROWBERRY.

EMPHASIS, n. ēm'fă-sis [L. and Gr. *emphasis*, forcible expression—from *em*, in or on, and Gr. *phēmi*, I speak, I assert]: the stress or force of the voice put upon a particular word or syllable to increase its significance (see ACCENT); impressiveness of expression. **EM PHASIZE**, v. -sīz, to pronounce certain words with a particular force of the voice. **EM'PHASI'ZING**, imp. **EM'PHASIZED**, pp. -sīzd. **EMPHAT'-IC**, a. -făt'ik [Gr. *emphatikos*]: uttered with emphasis; forcible; strong; also **EMPHAT'ICAL**, a. -i kăl. **EMPHAT'-ICALLY**, ad. -lī.—**SYN.** of ‘emphatic’: impressive; energetic; striking; earnest.

EMPHLYSIS, n. ēm'fli-sis [Gr. *em* or *en*, in, upon; *phlusis*, a vesicular tumor, an eruption—from *phluō*, I boil, I bubble up]: in *med.*, vesicular tumor or eruption, proceeding from an internal and febrile affection, including miliary fever, thrush, cowpox, pemphigus, and erysipelas.

EMPHRACTIC, a. ēm-frăk'tik [Gr. *em* or *en*, in; *phrassō*, I obstruct, I block up]: in *med.*, having the quality of closing the pores of the skin.

EMPHYSEMA, n. ēm'fī-sē'mā [Gr. *emphusēmā*, inflation—from *em*, in; *phusan*, to blow]: in *med.*, unnatural distention of a part with air. Emphysema of the cellular texture often takes place in the neighborhood of wounds of the air-passages in the lungs, and is the consequence of an escape of air from these parts. Emphysema of the lungs is the consequence either of distention or of rupture of the air vesicles, especially on the surface. It is rarely that emphysema is produced otherwise than mechanically; but collections of fluid in a state of decomposition sometimes give out gases, which penetrate and distend the textures with which they are in contact. **EM'PHYSEM'ATOUS**, a. -sēm'ū-tūs, characterized by the presence of air, or a light puffy humor.

EMPHYTEUSIS, n. ēm'fī-tū'sis [L. *emphyteu'sis*, a planting—from Gr. ēmp̄h̄teu'ō, I plant or improve land]: in law, grant of land or houses for ever, or for a very long lease, on condition of a fixed annual payment to the proprietor or superior. In Roman law, the emphyteusis much resembled feudal holdings, so much so, indeed, that Craig and other Scotch writers apply the term to them. It is used in the same sense as Eng. *fee* and *fief*, Scotch *feu*.

EMPIDÆ—EMPIRIC.

The sum paid to the superior was called the *canon emphyteuticus*. The tenant handed down the right to his heirs, and was entitled to sell, but only on condition of giving the first offer to the dominus. The consent of the lord, however, was not necessary to entitle him to impignorate the emphyteuta (things thus hired) for his debt. Justinian put the emphyteusis and the *ager rectigalis* on the same footing. The latter is the term applied to lands leased by the Roman state, by towns, ecclesiastical corporations, and by the vestal virgins. There were several ways in which the right of emphyteusis might cease. If the tenant died without heirs, it reverted to the dominus. He might also lose his right by injuring the property, by non-payment of his rent or public burdens, or by alienation without notice to the dominus. It was also in his power to renounce it.
EMPHYTEUTIC, a. *emfi-tū'tik*, taken on hire.

EMPIDÆ, n. *ēm'pi dē* [Gr. *empis*, a mosquito, a gnat—from *eilos*, form]: family of *Diptera*, with short antennæ. They are not really akin to gnats, except that they fly in numbers over water in summer evenings. They are of small size, and live partly on other insects and partly on the juice of flowers. *Empis* is the type.

EMPIRE, n. *ēm'pir* [F. *empire*—from L. *imperium*, command, power: It. *imperio*]: the dominions of an emperor, usually including several nations or nationalities; dominion; supreme control; governing influence or command: see EMPEROR.—**SYN.**: kingdom; dominion; sway; rule; control; reign; sovereignty; state; government; power; realm; commonwealth.

EMPIRIC, n. *ēm-pir'ik* [OF. *empirique*, an empiric—from L. *empiricus*: L. *empirici*; Gr. *empeīrikoi*, physicians who followed a system based on practical experience alone—from Gr. *em*, in; *peira*, an effort, a trial]: one whose knowledge and practice are founded on experience; one who practices medicine without being regularly educated; a pretender to medical skill; a quack. It is difficult to say at what period, or in what manner, this word began to degenerate from its original meaning. Probably the idea was, that empiricism, or experimental science, excluded the reasoning faculty, because it did not require, or at least was not based on, scientific theory; and, therefore, the profession of empiricism came to be synonymous with vulgar ignorance. The empirics were a regular sect of ancient physicians in the time of Celsus and Galen, who gives us some insight into their modes of thought and practice. They laid great stress on the unprejudiced observation of nature; and thought that, by a careful collection of observed facts forming a history, the coincidence of many observations would lead to unalterable prescriptions for certain cases. The later adherents of the school excluded all theoretical study, even that of anatomy, and were guided solely by tradition and their individual experience. By an empiric in medicine is now understood a man who, from want of theoretic knowledge, prescribes remedies by guess according to the name of the disease or to individual

EMPLAD—EMPOLI.

symptoms, without thinking of the constitution of the patient or other modifying circumstances. What are called *specifies* are administered on this principle, or want of principle. **EMPIRIC**, a. or **EMPIRICAL**, a. -*ɪ-kəl*, resting only on experience; applied without science. **EMPIRICALLY**, ad. -*lɪ*, without science; in the manner of a quack. **EMPIRICISM**, n. -*sɪzɪsm*, reliance on observation and experience without rational theories as to the cause; the practice of medicine without a medical education; quackery. **EMPIRICAL FORMULA**, in *chemistry*, mode of expressing the constituents of a compound in symbols, where the total quantity of each element is written down without reference to any particular order or state of combination. Thus, alcohol consists of 4 equivalents of carbon, 6 of hydrogen, and 2 of oxygen; and its empirical formula is C₂H₆O. When regarded, however, as a member of a family group, the constituents are arranged in a more systematic manner, as in C₂H₅(OH), representing the theoretical constitution of alcohol, which, strictly speaking, is the hydrated oxide of ethyl. Again, the rational formula of Epsom salts, which is MgSO₄·7H₂O, represents it theoretically as a hydrated sulphate of magnesia; while the empirical formula MgH₁₁SO₁₁ merely tells us that it consists of 1 equivalent of magnesium (Mg), 1 of sulphur (S), 7 equivalents of hydrogen, and 14 equivalents of oxygen. **EMPIRICAL LAWS**, such as express relationships, which may be merely accidental, observed to subsist among phenomena, but which do not suggest or imply the explanation or cause of the production of the phenomena. They are usually tentative, and form stages in the progress of discovery of causal laws. Bode's law of the distances of the planets from the sun is an example.

EMPLAD, v. ēm-*plēd'* [em, and *plead*]: to prefer a charge against; to indict: see **IMPLEAD**.

EMPLECTON, or **EMPLECTUN**, n. ēm-*plēk'tūn* [Gr. *em-plektos*, interwoven, *en*, in; *plekō*, I weave, I twine]: kind of masonry having a squared stone face; in the Greek it is represented as solid throughout, and in the Roman having a filling of rubble. One form of Roman emplecton has courses of tiles at intervals.

EMPLOY, v. ēm-*ploy'* [F. *employer*—from mid. L. *implicārē*, to employ for some one's profit—from *em*, in or on; L. *plicō*, I fold]: to keep busy or at work; to use; to exercise; to engage the services of any one; to apply or devote to an object: N. business; occupation. **EMPLOYING**, imp. **EMPLOYED'**, pp. -*ployd'*. **EMPLOYMENT**, n. that which engages the time and attention of any one; occupation. **EMPLOYER**, n. one who engages or keeps in service. **EMPLOYÉ**, n. āng-*ploy ā*, also English form, **EMPLOYEE**, n. ēm-*ploy'ē* [F. *employé*]: one who is engaged in any occupation.—SYN. of 'employment': business; avocation; engagement; office; service; agency.

EMPOLI, ēm'pō-lē: town of Italy, province of Florence, in a remarkably beautiful and fertile district on the left bank of the Arno, 16 m. w.s.w. of Florence. It is a thriving

EMPORIA—EMPTY.

ing town, surrounded by walls flanked with towers, and though its streets are narrow, it is on the whole well built, and has some good squares. The most interesting building is the Collegiate Church, built 1093, the fine original façade of which has suffered little from modern *improvements*, though the other portions of the building were considerably altered 1738. This church contains several good paintings, and has some excellent specimens of sculpture, among which is one by Donatello. E. has several manufactories of cotton, leather, straw-hats, and glass, considerable trade in agricultural produce, and a weekly market of some importance. Pop. 7,500.

EMPORIA, ēm-pō'ri-a: city, cap. of Lyon co., Kan.; on the Neosho river, 6 m. above its junction with the Cottonwood; on the Mo. Kan. and Tex. railroad 28 m. w.n.w. of Burlington, 61 m. s.e. of Junction City, 61 m. s.s.w. of Topeka. It has a court-house, state normal school, Presb. college, 8 churches, 2 national banks (cap. \$200,000), 2 state banks (cap. \$97,500), public, Anderson Memorial, and college libraries, 2 daily and 5 weekly newspapers, 3 flour mills, foundry, and furniture, woolen goods, brooms, soap, carriage factories; is in an agricultural and grazing region. Pop. (1870) 2,168; (1880) 4,631; (1900) 8,223.

EMPORIUM, ēm-pōr'ī-ūm [L. *empōrium*; Gr. *empōrion*, a place of trade, a market-place: It. *emporio*]: a mart or place for sale of goods; a city or town with extensive commerce. The word is from *emporos*, which in later Greek meant a wholesale merchant, as opposed to a retailer who was called *kapēlos*. E. thus came to be applied to the receptacles in which wholesale merchants stowed their goods in seaports and elsewhere, and thence to cities with great warehouses.

EMPOWER, v. ēm-pow'r [em, and power]: to give authority or power to; to commission or authorize. **EMPOW'-ERING**, imp. -pow'ring. **EMPOW'ERED**, pp. -pow'rd.

EMPRESS: see under **EMPEROR**.

EMPROSTHOTONOS, n. ēm-prōs-thōl'on-ōs [Gr. *emprosthen*, before; *teinō*, I draw]: spasm which bends the body forward and confines it in that position. This sometimes happens with tetanus. Note.—*Emprosthotonia* would be a better term than *Emprosthotonos*, which is properly an adjective.

EMPTION, n. ēm'shūn [L. *emptiōnem*, purchase—from *ēmō*, I buy]: in law, the act of buying; a purchase: see **SALE OF GOODS**.

EMPTY, a. ēm'tī [AS. *æmtig*, vacant, empty—from *æmta*, leisure, rest]: containing nothing except air; void; vacant; unsubstantial; unsatisfactory; without force; senseless; vain; ignorant: V. to make void; to exhaust; to pour out the contents: N. a case or package without its contents. **EMP'TYING**, imp. **EMP'TIED**, pp. -tīd. **EMP'TINESS**, n. -nēs, state of containing nothing; voidness; inability to satisfy desire.—SYN. of 'empty, a.': hollow; destitute; waste; deserted; desolate; unfruitful.

EMPTYYSIS—EMU.

EMPTYYSIS, n. *ēmp'tī-sīs* [Gr. *emptuō*, I spit upon—*em* or *en*, in, upon, and *ptuō*, I spit out or up]: in *med.*, spitting of blood from the mouth, the fauces, or the parts adjacent.

EMPYEMA, n. *ēm'pī-ē'mā* [Gr. *empūēmā*, a purulent discharge from the lungs—from Gr. *em*, in; *pūōn*, pus]: a collection of purulent matter in the cavity of the chest (exclusively, in present use in the pleura), causing pressure of the lung, and often attended by hectic fever: see **PLEURISY**.

EMPYREAL, a. *ēm'pī-rē'āl* [Gr. *empūrōs*, prepared by fire—from *em*, in or on; *pura*, fire: Sp. *empireo*: F. *empyrée*]: formed of pure fire or light; pure; vital; pertaining to the purest or highest region of heaven; ethereal. **EM-PYRE'AN**, a. *-pī-rē'ān*, same as *empyreal*: N. the highest heaven, the seat of Deity—there being five heavens according to Ptolemy.

EMPYREUMA, n. *ēm'pī-rō'mā* [Gr. *empūreū'mā*]: the peculiar burned smell and acrid taste of an animal or vegetable substance when burnt in a close vessel; the taste and smell are caused by *empyreumatic oil*, which does not exist naturally in the substance, but is formed in its decomposition by heat. **EM'PYREUMAT'IC**, a. *-rō-māt'ik*, or **-MAT'ICAL**, a. *-mūt'i-kāl*, pertaining to or possessing the taste of burnt animal or vegetable substances.

EMS: river in the n.w. of Germany, rising in Westphalia, at the s. base of the Teutoburger Wald, and flowing first n.w., then n. through the Hanoverian territories, emptying into Dollart Bay, an estuary of the German Ocean, after a course of 250 m. Its chief affluents are the Aa, the Haase, and the Leda. It is navigable for vessels of 100 tons as far as Pappenburg, 25 m. from Dollart Bay. The E. drains a basin of about 5,000 sq. m. In 1818, it was connected by a canal with the Lippe, and thus with the Rhine, which greatly increased its importance for commerce and navigation.

EMS, *ēms*, usually called the *Baths of Ems*, to distinguish it from other places of the same name: bathing-place known to the Romans, and celebrated in Germany as early as the 14th c. It is about four m. from Coblenz, near the most picturesque parts of the Rhine, in a beautiful valley in the province of Hessen-Nassau, traversed by the navigable river Lahn, and surrounded by wooded hills. Its warm mineral springs belong to the class containing soda; the only essential difference between the numerous springs is in the temperature varying from 24° to 46° Reaumur, and in the greater or less amount of carbonic acid gas contained. The bathing establishments are luxuriously fitted up, as are also the hotels and private lodging-houses.—Pop. (1880) 6,943; (1885) 6,731; (1890) 6,356.

EMU, n. *ē'mū*, or **EMEU** [Port. *ema*—from an Indian name], (*Dromaius*—or *Dromecius*—*Nova Hollandiae*): a very large bird, the ostrich of Australia, one of the *Struthionidæ* or *Brevipennes*. It is a native of Australia, and

EMU.

widely diffused over the s. parts of that continent and the adjacent islands. It is by some ornithologists referred to the same genus with the cassowary, but the differences are considerable; the bill being horizontally depressed, while that of the cassowary is laterally compressed, the head feathered, and destitute of bony crest; the throat is nearly naked, and has no pendent wattles; the feet are three-toed as in the cassowary, but the claws are nearly of equal length. The name E. was given by the older voyagers and naturalists to the cassowary, but is now the invariable designation of the Australian bird. The emu is even taller than the cassowary, which it resembles in the general character of its plumage. Its wings are mere rudiments hidden beneath the feathers of the body. Its color is a dull brown, mottled with dingy gray; the young are striped with black. When assailed, it strikes backward and obliquely with its feet, like the cassowary, and it is so powerful that a stroke of its foot is said to be sufficient to break a man's leg. Dogs employed in hunting it are often injured by its kicks, but well-trained dogs run in before it, and spring at its neck. It cannot fly, but runs very fleetly. It is timid and peaceful, and trusts altogether to its speed for safety, unless hard pressed. In a wild state, it sometimes occurs in small flocks; but it has now become rare in



Emu, and Young.

all the settled parts of Australia. The extinction of the species may perhaps be prevented by its domestication; as its flesh is excellent, and it is very easily domesticated, and breeds readily in that state. It has frequently bred in Britain. The eggs are six or seven in number, dark green; the male performs the principal part of the incubation. The eggs are highly esteemed as food. The skin of the emu contains much oil—six or seven quarts are obtained from a single bird, and on this account it has been much hunted in Australia. The food of the emu consists chiefly

EMULATE—EMYDIUM.

of roots, fruits, and herbage. Its only note is a drumming sound, which it frequently emits.

EMULATE, v. ēm'ū-lāt [L. *amūlātūs*, rivalry, emulation: It. *emulare*]: to strive to equal or excel; to vie with; to rival. **EM'ULATING**, imp. **EM'ULATED**, pp. **EM'ULATOR**, n. -tér, one who. **EM'ULA'TION**, n. -lā'shūn [F.—L.]: competition; rivalry; endeavor to equal or excel. **EM'ULA'TORY**, a. -lā'tér-ī, connected with emulation or rivalry. **EM'ULOUS**, a. -lūs, eagerly desirous of equalling or excelling. **EM'ULOUSLY**, ad. -lī. **EM'ULATIVE**, a. -lā-tīv, rivalling; disposed to competition. **EM'ULA'TIVELY**, ad. -lī.—**SYN.** of 'emulation': ambition; contention; contest; strife.

EMULGENT, a. ē-mūl'jēnt [F. *emulgent*—from L. *emulgen'tem*, draining out—from *e*, out of; *mūlgēō*, I milk: It. *emulgere*, to drain]: milking or draining out. **EMUL'SION**, n. -shūn [F. *émulsion*: L. *emūlsūs*, 'milked out']: a liquid for softening, etc., formed by the mixture of milk and oil; oil or fat diffused throughout another fluid in the form of minute globules. The term denotes those preparations in pharmacy obtained by triturating certain substances with water, producing a milky white opaque mixture of a gummy consistence, and composed more or less of oily particles floating in mechanical suspension in the mucilaginous liquid. The *true* and *oily* emulsions are those containing true oil, as the emulsion of bitter almonds, obtained by bruising the latter in a mortar with water; and the *false*, or *not oily*, are those where no true oil is suspended, as where camphor, balsams, or resins are rubbed up with the yolk of egg, mucilage, or dilute spirit of wine. **EMUL'SIVE**, a. -sīv, yielding a milk-like substance; softening.

EMULOUS: see under **EMULATE**.

EMULSIN, ē-mūl'sīn; or **SYNAPTASE**, sīn'āp-tās: peculiar ferment present in the bitter and sweet almond, and which forms a constituent of all almond emulsions. When bitter almonds are bruised, and water added, the E. acts as a ferment on the amygdaline, and decomposes the latter into volatile oil of bitter almonds, prussic acid, grape-sugar, formic acid, and water (see **ALMONDS**, **FIXED OIL OF: ALMONDS**, **VOLATILE OIL OF**). The vegetable albumen of almonds is almost entirely composed of E.; which, when separated, is a white substance, soluble in water, and distinguished by its remarkable power of causing the fermentation of amygdaline. It consists of carbon, hydrogen, nitrogen, and oxygen.

EMUNCTORY, n. ē-mūngk'tér-ī, **EMUNC'TORIES**, n. plu. -tér-īz [L. *emunctus*, wiped or blown, as the nose]: a part of the body where anything excrementitious is collected or separated in readiness for ejection.

EMYDIDÆ, n. plu. ēm-ī-dī'dē [Gr. ēmūs, water-tortoise]: the fresh-water turtles or mud-tortoises; also **EMYS**, ē'mīs.

EMYDIUM, n. ē-mīd'ī-ūm [Latinized dim. of Gr. *emus*, a water-tortoise]: in zool., genus of *Arachnida*, order *Colopoda*, tribe or family *Tardigrada*.

EMYS—ENALLOSTEGA.

EMYS, ē'mīs: genus of marsh tortoises (popularly called mud-turtles), from which the whole family of marsh tortoises is sometimes called *Emydæ*. The chelonians of this family are numerous, and widely diffused throughout the warmer parts of the world. They differ from land-tortoises more in their habits than in their appearance and structural characters. Their carapace, however, is more flattened, and their feet are more expanded and webbed, so that they swim with great facility. They feed chiefly on animal food, as insects and mollusks, aquatic reptiles, and fishes, some of them even preying upon birds and mammalia, which come within reach. Two or three species of *Emydæ* are natives of the s. of Europe; but there are many species in the United States; among the most common are the Painted Turtle (*Chrysemys picta*) and the Box Turtle (*Cistudo Carolina*). The flesh of *Cistudo europaea* is esteemed for food. This small species, about ten inches long, an inhabitant of lakes, marshes, and muddy places in the s. and e. of Europe, is sometimes kept in ponds, and fattened for the table on lettuce-leaves, bread, etc.

EN, prefix, ēn [F. *en*: L. *in*: Gr. *en*: AS. *em*]: EN becomes *em* before *b*, *p*, or *m*; Gr. *en* signifies *in* or *on*; F. *en* comes from the L. *in*, and signifies *in* or *into*. EN is often used as a prefix to augment the force of the word, or to intensify its meaning. EN, for AS. *em*, signifies to make, to surround; some words are written indifferently with *en* or *in* as the prefix.

ENABLE, v. ēn-ā'bl [en, and *ab'e*]: to make able; to supply with power; to furnish with sufficient means or ability; to authorize. ENA'BLING, imp. -bling. ENA'BLED, pp. -bld.

ENACT, v. ēn-ākt' [en, and *act*]: to make, as a law; to establish by authority; to decree; to pass into a law, as a bill by parliament; to act or do. ENAC'TING, imp.: ADJ. giving legislative sanction to a bill in order to establish it as a law; giving legislative sanction. ENAC'TED, pp. ENAC'TIVE, a. -tiv, having power to enact. ENACT'MENT, n. -mēnt, a measure or bill passed into a law; the passing of it. ENAC'TOR, n. -tōr, one who.

ENALIOSAURIA, n. plu. ēn-ā'lī-ō-saw'rī-ă, or -SAU'RİANS [Gr. *enaliōs*, marine; *sauros*, a lizard]: in geol., a group or order of fossil reptilians, including the ichthyosaurs and plesiosaurs: see ICHTHYOSAURUS: PLESIOSAURUS.

ENALLAGE, n. ēn-āl'lā-jē [Gr. *enallāgē*, an exchange—from *allassō*, I change]: in gram., a change of words, or a substitution of one gender, case, etc., for another.

ENALLOSTEGA, n. ēn-āl-lo-stē'ga [Gr. *enallos*, changed, contrary; *stegē*, a roof]: in zool., type of the *Enallostegidae*, a family of *Rhizopoda*, having simple cells arranged in two alternate series.

ENAMEL.

ENAMEL, n. *ēn-ām'ēl* [*en*, in; F. *émail*; OF. *esmail*, enamel: It. *smalto*; Ger. *schmelz* (from same root as *smelt*) color produced by melting glass with a metallic oxide]: a kind of fine glass, variously colored, used for covering articles with a fine glossy surface; any hard glossy surface, as of the teeth (see TEETH); that which is enamelled: V. to coat or paint with enamel; to form a glossy substance on. ENAMELLING, imp.: N. the act or art of painting with enamel. ENAMELLED, pp. -*ēld*: ADJ. covered with enamel; adorned with anything resembling enamel. ENAMELLER, n. one who.—Enamel denotes vitrified substances of various composition applied to the surface of metal, wood, paper, etc. Enamelling is practiced for utility, as in making the dial-plates of watches and clocks, coating the insides of culinary vessels, etc.; also for ornament and beauty—artistic designs, figures, portraits, etc., when it belongs to the fine arts. Both the composition of enamels and the processes of applying them are intricate subjects, besides being in many cases kept secret by the inventors. The basis of all enamels is an easily fusible colorless silicate or glass, to which the desired color and the desired degree of opaqueness are imparted by mixtures of metallic oxides. The molten mass, after cooling, is reduced to a fine powder, and washed, and the moist paste is then usually spread with a spatula upon the surface to be enamelled; the whole (if the substance be as usual, metal) is then exposed in a furnace (*fired*, as it is called) till the enamel is melted, when it adheres firmly to the metal. The metal most commonly used as a ground for enamel is copper; but for the finest kinds of enamel-work gold and silver also are used.

Artistic or Ornamental Enamelling.—This art is of great antiquity: it is found on Egyptian remains; from the Egyptians it passed to the Greeks, and it was extensively employed in decoration by the Romans. In the reign of Augustus, the Roman architects began to make use of colored glass in their mosaic decorations; various Roman antiquities, ornamented with enamel, have been dug up in Britain, and it was adopted there by the Saxons and Normans. A jewel found at Athelney, in Somersetshire, and now preserved in the Ashmolean Museum at Oxford, is proved by the inscription on it to have been made by order of Alfred; and there are various figures with draperies partly composed of colored enamel on the sides of the gold cup given by King John to the corporation of Lynn, in Norfolk.

Enamelling has been practiced from a remote period in the East, Persia, India, and China, under a separate and distinct development; but there is nothing from which it can be inferred that the various methods were in use earlier than in Europe. As a decoration, enamelling was more popular, and attained greater perfection in the middle ages, than in classic times. It was extensively practiced at Byzantium from the 4th until the 11th c., afterward in Italy in the Rhenish provinces, and at Limoges in the s. of France, where it was successfully followed out till a comparatively late period, in several different styles. The Byzantine and

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other early styles of enamel-work down to the 17th c. were generally employed in ornamenting objects connected with the service of the church, such as reliquaries, pyxes, church-candlesticks, crosiers, portable altars, the frontals of altars, etc.; the art was greatly used also in ornamenting jewelry, and vessels made for use or display in the mansions of the rich; such as salt-cellars, coffers, ewers, plateaux, candlesticks, etc. After this period, the art declined, until a new phase of it was invented in France, in which enamel is used as a ground, and the figures are painted with vitrified colors on the surface of it. This is enamel-painting properly so called, the earlier styles being more of the nature of mosaics.

Distinguished with reference to the manner of execution, enamel-work may be divided into four kinds: 1. *Cloisonnée*, or inclosed, the method of the Byzantine school, in which the design is formed in a kind of metal case, generally gold or copper, and the several colors are separated by very delicate filigree gold bands, to prevent them running into each other. 2. *Champ Levé*, practiced by the early Limoges school. In this process, the ornamental design, or the figures that were to be filled in with color, were cut in the metal (generally copper) to some depth; and wherever two colors met, a thin partition of the metal was left, to prevent the colors running into each other by fusion when fired. 3. Translucent enamel, which had its origin, and was brought to great perfection in Italy, was composed of transparent enamel of every variety of color, laid in thin coatings over the design, which was incised on the metal, generally silver, the figure or figures being slightly raised in low relief, and marked with the graver, so as to allow the drawing of the contours to be seen through the ground, instead of being formed by the coarse lines of the copper, as in the early Limoges enamels. 4. Surface-painted enamels, which may be divided into two stages. The first stage, which is known as the *late Limoge* style, sprang up under Francis I. of France (1515-47). In this the practice was to cover the metal plate with a coating of dark enamel for shadows, and to paint on this with white, sometimes set off with gold hatchings, sometimes having the hands and other parts of the figures completely colored. The designs were generally taken from well-known paintings or engravings of the period; and the style of the designs was strongly influenced by that of the Italian artists employed by Francis I. This style soon degenerated, and gave place to the latest or *miniature* style, invented before the middle of the 16th c. by Jean Toutin, goldsmith at Chateaudun, and carried to the highest perfection by Jean Petitot, miniature-painter (born Geneva, 1607), who resided long in England, and then in Paris. In this the plate is covered with a white opaque enamel, and the colors are laid on this with a hair-pencil, and fixed by firing. The paints are prepared by grinding colored enamels with some kind of liquid, and when fused by the heat, they become incorporated with the enamel of the ground. The earlier enamellers of this school occupied themselves with miniatures, snuff-boxes,

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and other trinkets, till the period of the French Revolution, when the art fell into disuse. It was revived in England early in this century; and copies of portraits and pictures on a much larger scale than the French miniatures were executed with much success by H. Bone, R.A., and Charles Muss. Works of this description possess the obvious advantage of durability; but those various qualities of texture, and the delicacy of color for which good works in oil or water-color are prized, cannot be attained in enamel copies; and it is to be regretted that greater efforts are not made to turn enamelling to account in the way of ornamentation, for which it is so admirably fitted—rather than in attempts at imitating works classed strictly as within the bounds of fine art—and to put in practice the older styles of enamelling, particularly those denominated *champ levé* and transparent enamelling.

Enamelled-ware.—The liability of iron to oxidation by heat or moisture, and to corrosion even by the weakest acids, has led to many attempts to coat it with a protecting surface. Ordinary tin plate is the oldest and most familiar example of a partially successful method. Since the beginning of the present century, many attempts have been made to cover iron with a vitreous surface, and several patents have been taken for such methods of enamelling. The chief difficulty in applying enamels to iron arises from the tendency of the metal to oxidize before it reaches the temperature at which the enamel fuses, and to become brittle from the oxide combining with the silica of the enamel. This action being superficial, the mischief is the greater in proportion to the thinness of the iron. Therefore it is much easier to enamel thick cast-iron vessels than thin vessels made of sheet-iron. A glass may be made by combining either silicic acid or boracic acid with a base; the latter fuses at a lower temperature than the former, but the glass is much more expensive and less durable than the silica glass. The enamels used for coating iron consist of a mixture of silica and borax, with various basic substances, such as soda, oxide of tin, alumina, oxide of lead, etc.

The best enamel for such purposes generally known, is that patented 1850 by C. H. Paris, and applied on a large scale at Birmingham. It consists of 130 parts of flint-glass powdered, 20½ parts of carbonate of soda, 12 of boracic acid. These are fused together to form a glass, then reduced to a very fine powder; the article to which they are to be applied is carefully cleaned with acid, then brushed over with gum water, and the powder dusted upon it. The gum water is merely to cause adhesion. This coating is then carefully dried, and heated just to the point at which the powdered glass will fuse, and by running together, coat the surface. The enamel is generally put on in two separate layers or coatings, the first being dull gray, and the second or outer one of some brighter color. For sheet-iron hollow-ware, the latter is usually white, upon which a pattern is often printed with transfer paper by the process in use for earthenware (see POTTERY). These light enamelled iron vessels, being practically indestructible (except

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when used for cooking), are made in large numbers for use on board ships, and for colonial markets. A great variety of articles, many of them beautifully decorated in colors, such as grate-fronts, clock-dials, panels of different kinds, tablets, and name-plates, are now executed in enamelled iron at moderate cost. It is also applied to corrugated roofing. Clarke's and other patent enamels have been successfully applied to saucerpans, small cisterns, pipes, and other articles of *cast iron*. See HOLLOW-WARE.

The action of sudden heat is to expand the metal more than the enamel, and cause the latter to peel off. Acids find their way through minute invisible pores, which exist in the best enamel; and when once they reach the iron, they rapidly spread between it and the enamel, and undermine and strip it off. This kind of action is curiously shown by filling an enamelled vessel with a solution of sulphate of copper. The acid attacks the iron wherever pores exist, and little beads of metallic copper are deposited at all such spots; these beads go on growing until they are large enough to be very plainly seen. This is the severest test for trying the continuity of enamelled surfaces, to which they can be subjected, as sulphate of copper will penetrate the glaze and body of ordinary earthen-ware.

Enamelling has long been applied to paper and card-board, giving a glossy surface. Recently, an enamelling process has been applied to walls, giving a fine hard surface, at small cost.

ENAMOR, v. *ĕn-ăm'ĕr* [F. *en*, in; *amour*, love: L. *amor*; It. *amore*, love: Sp. *enamorar*; OF. *enamorer*, It. *innamorare*, to inflame with love]: to charm; to captivate; to inflame with love. **ENAM'ORING**, imp. **ENAM'ORED**, pp. -*ĕrd*.

ENANTHEMA, n. *ĕn-ăñ-thĕ'ma* [Gr. *en*, in; and *an-thēma* (only used in composition)—from *antheō*, I bloom, I flower]: in med., name given to certain eruptions of the mucous membrane.

ENANTIOSIS, n. *ĕn-ăñ-ti-ō'sis* [Gr. contradiction—from *enantios*, opposite]: in rhet., figure of speech in which that which is meant to be conveyed is stated in the opposite.

ENARA, *ă-nă'ră*, or **ENARE**, *ă-nă'ră*: lake of Russia in the extreme end of Finland; lat. $68^{\circ} 30'$ — $69^{\circ} 10'$ n., and long. $27^{\circ} 30'$ — $28^{\circ} 45'$ e. It covers 1,200 sq. m., and has numerous islands. Its superfluous waters are discharged into the Arctic Ocean.

ENARËA, *ĕn-ă're-ă*: country of Africa s. of Abyssinia, within lat. 7° — 9° n., and long. 36° — 38° e., but its limits have not been definitely ascertained. It is inhabited by a portion of the Gallas tribes, who, owing to the continued communication which they keep up with Abyssinia, also to the residence of many Mohammedan merchants among them, are much more civilized than the Gallas usually are. Their government is a hereditary and absolute monarchy. The principal rivers of E. are the Gibbe and the Dodesa. Its coffee-plantations are so extensive as to deserve the

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name of woods; they occur chiefly along the banks of the Gibbe. E. is remarkable for manufactures of ornamented arms, and of cloths with embroidered borders. Besides these, it exports slaves, gold, ivory, civet, and skins, into Abyssinia. The king and a small portion of the population are Mohammedans, and it is said that native Christians have been found here. The capital is Saka, a place of considerable importance, near the river Gibbe.

ENARGITE, n. *ĕn-ăr'jĭt* [Ger. *enargit*—from Gr. *enargēs*, distinct, visible]: orthorhombic mineral, with metallic lustre; colors gray or iron-black; composition, sulphur, arsenic, copper, antimony, iron, and silver. It is found in N. America, Chili, etc.

ENARMED, a. *ĕn-ărm'd'*: in *heraldry*, having arms, that is, horns, hoofs, etc., of a different color from that of the body.

ENARTHROSIS, n. *ĕn'ăr-thrō'sis* [Gr. *cnaarthros*, jointed—from *en*, in; *arthron*, a joint]: in *anat.*, a ball-and-socket joint; the insertion of one bone into another to form a joint. It admits of the most extensive range of motion, and occurs in the hip and shoulder joints: see JOINT.

ENATION, n. *ĕ-nă'shŭn* [L. *enātus*, grown or sprung up—from *e*, out of; *nātus*, born]: the changes produced by excessive development in various organs of plants; the growth of adventitious lobes.

EN CABOCHON, *ăng' kă-bō'shōng* [F. *en*, in; *cabochon*, an uncut precious stone—from *caboche*, head]: applied to gems which are cut with a rounded top, as carbuncles, opals, etc.

ENCÆNIA, or **ENCENIA**, n. *ĕn-sē'nī-ă* [Gr. *engkainiă*, a festival in honor of the dedication of a temple, statue, etc.—from *en*, in; *kainos*, new]: festivals held on the anniversaries of the founding of cities, and the consecration of churches; at *Oxford* and *Cambridge*, ceremonies observed at the anniversary commemorations of founders or benefactors. See COMMEMORATION.

ENCAGE, v. *ĕn-kāj'* [*en*, and *cage*]: to shut up in a cage: also **INCAGE**.

ENCAMP, v. *ĕn-kămp'* [*en*, and *camp*]: to pitch tents or form huts for the usually temporary lodgment of an army or travelling party; to rest for a time, as an army or a company travelling. **ENCAMP'ING**, imp. **ENCAMPED'**, pp. *-kămpt'*. **ENCAMP'MENT**, n. a resting-place, usually temporary, sometimes (for soldiers) permanent, for an army or travelling company. There are *intrenched* camps, where an army is intended to be kept some time, protected against the enemy; *flying* camps, for brief occupation; camps of *position*, bearing relation to the strategy of the commander; and camps of *instruction*, to habituate troops to the duties and fatigues of war.

For the manner in which Roman camps were constructed, see CAMP. It is probable that the same general plan was followed until the invention of gunpowder. When cannon

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came into use, a new arrangement became necessary, to shield the army from long-range projectiles. Everything, indeed, relating to attack and defense, especially to the latter, is taken into account in choosing the locality of a camp. A healthy site, good water, security from floods, and plenty of fuel and forage, are the chief additional requisites in a good encampment.

An army, when in the field, usually encamps by brigades or divisions, roads and paths being arranged before the troops arrive. The infantry, cavalry, and artillery are so placed as to defend each other against a sudden attack. There is a chain of guards all around the spot; and the park of artillery is placed behind the troops. The sutlers and servants are in the rear of the camp, but not beyond the limits of the rear guard. The tents of the infantry are ranged in rows perpendicular to the front, each row containing the tents (q.v.) for one company. The circular tents, now much used, accommodate 15 men each. The cavalry are in like manner encamped in rows; but each circular tent accommodates only 12 men. There are streets or roads between the rows of tents, of regulated width; and the officers' tents are at a given distance behind those of the men; the subalterns' tents being nearest to those of the companies to which they respectively belong. As a general rule, the line of the whole encampment is made to correspond as nearly as practicable with that in which the troops are intended to engage the enemy when fighting is renewed; to which end the tents of each battalion are not allowed to occupy a greater space in front than the battalion itself would cover when in order of battle.

Often, in modern warfare, an encampment is not defended by artificial constructions; the commander seeks security for his troops in streams, marshes, difficult surface of country, and numerous advanced posts. Sometimes, however, more extensive defense-works are necessary; and the result is an *intrenched* camp, which becomes a fortified inclosure. The chief uses of such a camp are—to secure an army while covering a siege, or in winter-quarters, to accommodate a corps of observation while the active army is engaged elsewhere; or to defend a position near a fortified place. Care is taken that the site is not commanded by neighboring hills. All villages are occupied, and all obstacles removed, within a distance of half a mile or a mile. The area of ground selected is large enough to contain the necessary store of arms, ammunition, food, fuel, forage, and water, and to enable the troops to maneuver. The junction of two rivers is often selected as a favorable spot. Various defense-works are constructed around or near the spot, such as continuous earth-works, redoubts, flèches, etc. Camps of *instruction* may be either temporary or permanent. See ALDERSHOTT CAMP: BARRACKS. See also CANTON (CANTONMENT).

ENCARDION, n. ēn-kār'di-on [Gr. *en*, in, and *kardia*, the heart]: in bot., the pith or heart of vegetables.

ENCARPUS, n. ēn-kār'pūs [Gr. *en*, in, and *karpos*,

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fruit]: in *arch.*, sculptured ornament consisting of festoons of carved fruit and flowers, suspended between two points. The festoons are of the greatest size in the middle, diminishing gradually toward the points of suspension.

ENCASE, v. *ĕn-kăs'* [F. *encaisser*, to pack in a case: *en*, and *case*]: to inclose or hide, as in a case or cover: see INCASE.

ENCASH, v. *ĕn-kăsh'* [F. *encaisse*, cash in hand, cash-balance—from *encaisser*, to pack in a case]: to lay aside in ready money or as cash in hand for a special purpose. ENCASHING, imp. ENCASED, pp. *ĕn-kăsh't*, laid aside, as money, for a special purpose; paid in cash. ENCASHMENT, n. payment in cash or coins, as a bank bill.

ENCAUSTIC, n. *ĕn-kaw-s-tik* [OF. *encaustique*, wrought with fire—from L. *encausticus*; Gr. *engkausticos*, encaustic—from Gr. *en*, in; *kaustikos*, caustic—from *kaiō*, I burn]: method of painting with a wax medium by means of heat: ADJ. pertaining to the art of painting on earthenware in which the colors are burned in. ENCAUSTIC PAINTING, painting fixed by fire, practiced by the ancients. As the name implied that fire was used in the execution, some have been led to suppose that encaustic painting was the same as enamel painting; but notices by Pliny and other writers show clearly that it was a species of painting in which the chief ingredient used for uniting and fixing the colors was wax dissolved by heat. Various attempts have been made in modern times to revive it. After the middle of last century, ingenious attempts to revive it were made in Paris and London, but with only partial and temporary success. Later, it was again taken up in Germany under the patronage of the king of Bavaria, who had a number of important works executed in this way. The colors are ground, and laid on with a vehicle composed principally of wax. Miss Emily Greenland (Mrs. Hooker, of Rottingdean, 1792) had dissolved guin-arabic in water, afterward adding gum-mastic, dissolved by stirring and boiling, and when the mixture had reached the boiling point, she put in the wax. After painting the picture, she passed a thin coating of melted wax over it with a hard brush, and then drew over the surface an iron—for ironing linen—moderately heated. After the picture cooled, it was rubbed with a fine linen cloth. The German method is somewhat similar, but some other ingredients are used; among these, potash with the wax; and in place of an iron being passed over the surface, the wax is brought to the surface by a vessel containing fire being held at a little distance from the picture. Encaustic painting is not likely to come into general use; for neither in brilliancy of color, facility for execution, nor durability is it to be compared with oil-painting. ENCAUSTIC TILES, ornamental tiles of earthenware for floorings, extensively used from the 12th to the 15th c., chiefly for churches; revived for general use in modern times with great success. Strictly speaking, the name applies only to tiles with a pattern produced by layers of different-colored clays; but those also may be included.

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that are made of a single color where two or more kinds go to form a pattern. Of course a mosaic can thus be formed with tiles of various forms and various colors. Tiles of one color are made of dried slip—that is, the powder of carefully mixed and prepared clay. These 'dry tiles' are made by placing the colored clay powder in strong steel molds, and subjecting it to a pressure of several hundred tons, by means of a plunger fitting accurately into the mold. A depth of three inches of powder is compressed into a tile one inch in thickness. It is then removed, heated in a hot chamber, fired, and glazed if required.

The figured tiles are made in a different manner. The clay is worked in a moist state, but very stiff, first into square blocks. These are cut into square slices or slabs by passing a wire through them; upon this is put a facing of fine clay of the color of the ground of the pattern—another layer, of a different quality of clay, is sometimes added to the bottom, to prevent warping. It is then placed in a mold, with a plaster-of-Paris slab forming the top, on the under surface of which is the pattern in relief. This slab is pressed down, and thus forms a deep impression of the pattern to be produced in another color. The clay of the requisite color to form the pattern is now poured, semi-fluid, into this depression, and allowed to flow over the whole face of the tile; then it is set aside until dry enough to have its surface scraped and smoothed on a whirling table. By this means the superfluous clay is removed, and the pattern is brought out clear and well defined, the two colors of clay forming one smooth flat surface. The tile is then dried and fired.

By Malkin's patent process, inlaid as well as plain tiles are now made wholly of dried slip. The pattern is produced by the use of brass plates one-eighth of an inch thick, a separate one for each color. Thus, if it consist of an ornament in red and white on a blue ground, one plate is perforated so as to enable the red portion of the clay powder to be filled in, another is cut for the white portion, and a third for the blue ground. When all are filled up, the tile is pressed in a screw-press and fired.

ENCAVE, v. *ĕn-kāv'* [*en*, and *cave*]: to hide in a cave or recess.

ENCEINTE, a. *ăng-sāngt'* [F. *enceinte*—from mid. L. *incincta*, a pregnant woman—from L. *in*; *cinctus*, surrounded, girt]: pregnant; N. properly, fortified wall or rampart, or whole circle of defensive works around any place; though the term is applied also to the fortified area.

ENCENIA: see ENCAENIA.

ENCEPHALAR'TOS: see CAFFER BREAD.

ENCEPHALON, n. *ĕn-sĕf ā-lōn* or *ĕn-kĕf'-*, or **ENCEPH' ALOS**, n. *.lōs* [Gr. *engkēphālos*, what is in the head, the brain—from *en*, in; *kephalē*, the head]: the brain. **ENCEPH' ALA**, n. plu. *-lī*, molluscous animals having a distinct head; gasteropoda. **ENCEPH' ALOUS**, a. *-ă-lūs*, pertaining to those molluscous animals, as the limpet and periwinkle, which have a distinct head. **ENCEPHALIC**, a. *ĕn'sĕ-făl'ik*, belonging

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to the head or brain. ENCEPH'ALAL'GIA, n. -ăł-ăł'jî-ă [Gr. *algos*, pain]: a severe or deep-seated pain in the head. EN'CEPHALI'TIS, n. -sěf-ă-li'tis, inflammation of the brain. ENCEPHALOCELE, ěn-sěf'a-lo-sěl, tumor projecting through the skull, in one of the parts where the bones are incomplete in infancy, and consisting of a protrusion of the membranes of the brain, containing a portion of brain itself. The most common situation of such tumors is in the middle line and at the back of the head. Surgical interference is scarcely ever justifiable, and all that can usually be done is to give uniform support to the tumor, and to defend it from injury. ENCEPH'ALOID, a. -loyd [Gr. *eidos*, form]: resembling the materials of the brain. ENCEPHALOTOMY, n. ěn-sěf-al-ōt'o-mi [Gr. *tomē*, a cutting]: in *anat.*, dissection of the brain.

ENCHAFFE, v. ěn-chăf' [en, in, and *chafe*]: to enrage much; to provoke. ENCHAFFED, pp. ěn-chăft', provoked; chafed into rage.

ENCHAIN, v. ěn-chān' [F. *enchaîner*: *en*, and *chain*]: to bind or hold in chains; to hold fast or restrain. ENCHAIN'ING, imp. ENCHAINED', pp. -chānd'. ENCHAIN'MENT, n.

ENCHANT, v. ěn-chănt' [F. *enchanter*, to charm—from L. *incantārē*, to sing a magic formula over—from *in*, on; *canto*, I sing—lit., to sing magic formulas over]: to practice sorcery; to subdue by charms or spells; to delight in a high degree; to charm; to fascinate. ENCHANT'ING, imp. ENCHANT'ED, pp.: ADJ. inhabited by spirits, ghosts, or imaginary beings; subdued by charms; delighted in a high degree. ENCHANT'ER, n. one who. ENCHANT'MENT, n. the use of magic arts or spells; the magic arts themselves; an overpowering or irresistible influence which fascinates or delights. ENCHANT'RESS, n. fem. a woman who charms or fascinates; a sorceress. ENCHANT'INGLY, ad. -li —SYN. of ‘enchânt’: to captivate; enrapture; ravish; bewitch; enslave;—of ‘enchantment’: incantation; spells; necromancy; charms; magic; sorcery; witchery; witchcraft.

ENCHASE, v. ěn-chăs' [F. *enchasser*, to inchase—from *en*, in; *chassis*, a frame; *châsse*, a reliquary]: to inclose in another body partially, as a jewel in gold; to adorn with embossed or raised work; to adorn any work in metal by figured work. ENCHA'SING, imp.: N. the art of enriching or adorning works in gold, silver, etc. ENCHASED', pp. -chăst'.

ENCHEAR, v. ěn-chēr' [en, and *chear* for *cheer*]: in *OE.*, to fill with joy and courage.

ENCHEASON, n. ěn-chē'sn [OF. *enchaison*]: in *OE.*, occasion.

ENCHELINÆ, n. ěng-kĕl-ī'nē, or ENCHELI'NA, n. -kĕl-ī'na [Gr. *engchelus*, an eel]: in *zool.*, sub-family of infusorial animalcules, family *Trichodidæ*. They have no carapace; cilia round the mouth; and the rest of the body naked. ENCHELYS, or ENCHELIS, n. ěng'kĕ-lis, typical genus of the sub-family *Enchelinæ*. Four species are known. Accord-

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ing to Meyen some of the red and green snow plants described as *Confervæ*, and placed in the genus *Protococcus* are the infusorial animalcules, *Enchelis sanguinea* and *E. pulvisculus*. Others are genuine protococci.

ENCHONDROMA, n. ēn'kōn-drō'mā [Gr. *en*, in; *chondros*, cartilage]: abnormal cartilaginous growth; tumor somewhat smooth on its surface, occurring mostly in connection with the bones and with some of the glandular structures: see TUMOR.

ENCHORIAL, a. ēn-kō'rī-ăl [Gr. *engchōriōs*, of the same country, domestic—from *en*, in; *chōrōs*, a place]: native; popular—applied to the common writing of the anc. Egyptians, as distinguished from the hieroglyphic: see HIEROGLYPHICS.

ENCINA, or ENZINA, ēn-thē'nā, JUAN DEL: 1468–1534; founder of the Spanish drama; b. Old Castile. He studied in the Univ. of Salamanca, removed to Madrid, and under the patronage of the Duke of Alva began entertaining his friends with representations of original comedies about 1492. Subsequently he joined the clerical order in Rome, and was appointed ‘maestro di capella’ to Pope Leo X., and prior of Leon. He published a collection of dramatic and lyrical poems 1496, a farce *Placida e Victoriano* 1514, made a journey to Jerusalem 1519, published *Trabagia ó Via Sacra de Hierusalem* 1521, and after death was buried in Salamanca cathedral.

ENCIPIENT, n. ēn-sip'ē-ĕnt [L. *en*, in; *capiō*, I take]: a palatable vehicle, such as bruised coriander-seeds, in which cattle may take a medical preparation.

ENCIRCLE, v. ēn-sēr'kl [en, and *circle*]: to inclose with a ring; to embrace; to go round; to surround. ENCIRCLING, imp. -klīng. ENCIR' CLED, pp. -kld.—SYN. of ‘encircle’: to inclose; encompass; environ; circumscribe; bound; limit; confine.

ENCKE, ēnk'kēh, JOHANN FRANZ: astronomer: 1791, Sep. 23—1865, Sep 2; b. Hamburg, where his father was a clergyman. After studying at Göttingen, he served during the campaign of 1813–4 in the artillery of the Hanseatic legion, and 1815 in the Prussian army, as lieut. of artillery. On the establishment of peace, he left the service, and became asst., and afterward principal astronomer in the observatory of Seeberg, near Gotha. In 1825, chiefly at the instigation of Bessel, he was called to Berlin as successor to Tralles, in the secretaryship of the Acad. of Sciences, and as director of the observatory. While at Gotha, the astronomical prize offered by Cotta was awarded to E. by the judges Gauss and Olbers, for his determination of the orbit of the comet of 1800. This led him to solve another problem, which had been proposed with the other—viz., the distance of the sun. The solution, by means of the two transits of Venus 1761 and '69, is published in two separate tracts (*Die Entfernung der Sonne*, Gotha 1822–24). In 1819, he proved that the comet discovered by Pons, 1818, Nov. 26, revolved in the hitherto incredibly short period of about 1,200 days, and had been

ENCLAVE—ENCORE.

already observed 1786, 1795, and 1805. It has since borne the name of E.'s comet, and has appeared regularly; the period of its recurrence being 3.29 years, or about $3\frac{3}{16}$ years: see COMET. E.'s researches on this subject are contained in the *Transactions of the Berlin Academy*. In 1830, he undertook to edit the Berlin *Astronomical Almanac*, in which he published a number of astronomical treatises. Three vols. have appeared of *Astronomical Observations at the Berlin Observatory*, begun 1855.

ENCLAVE, n. ēn-klāv', F. áng-kláv' [F. a mortise—from *en*, in; L. *clavis*, a key]: in *geog.*, territory, country, or place which is completely surrounded by the territories of another power; in *her.*, anything represented as let into something else, particularly when the thing so let in is square.

ENCLITIC, a. ēn-klič'ik [Gr. *engkličikos*, inclined—from *en*, in; *klinō*, I bend]: inclining or leaning upon: N. a word or particle joined to the end of another, forming one word, as *ne*, in the Latin word *nonne*; in *Greek*, a particle or word which throws the accent back on a former syllable. **ENCLIT'ICAL**, a. -č'-kāl, pertaining to. **ENCLIT'ICALLY**, ad. -č'-lī.

ENCLOSE, v. ēn-klōz' [F. *enclos*, an inclosure; *en*, and *close*]: to encircle; to surround; to shut in between other things; to cover with a wrapper or envelope. **ENCLOSING**, imp. **ENCLOSED'**, pp. -klōzd'. **ENCLOSURE**, n. -zhūr, the act of inclosing; that which incloses or is inclosed; that which is contained in an envelope; space inclosed; common land when inclosed and appropriated; also spelled with IN, as **INCLOSE** (q.v.).

ENCÉLIUM, n. ēn sē'lī-ūm [Gr. *engkoilos*, hollowed out, because the fronds are tubular]: in *bot.*, genus of *Algae*.

ENCOMBERMENT, n. ēn-kūm'bér-měnt [*en*; Dut. *komber*, trouble: mid. L. *combri*, obstruction by trees in a forest: F. *encombre*, an impediment]: in *OE.*, encumbrance, which see; obstruction; hindrance.

ENCOMIAST, n. ēn-kō'mi-ăst [Gr. *engkōmioñ*; L. *en-cōmīūm*, praise: Gr. *engkōmīastēs*, a praiser]: one who praises another; a panegyrist. **ENCO'MIAS'TIC**, a. -ăs'tīk, bestowing praise; laudatory; also **ENCO'MIAS'TICAL**, a. **ENCO'MIAS'TICALLY**, ad. -lī. **ENCO'MIUM**, n. -mī-ūm, high praise or commendation; panegyric. **ENCO'MIUMS**, n. plu.—SYN. of ‘encomium’: eulogy; applause; praise.

ENCOMPASS, v. ēn-kūm'păs [*en* for *in*, and *compass*]: to surround; to encircle; to inclose. **ENCOM'PASSING**, imp. **ENCOM'PASSED**, pp. -păst. **ENCOM'PASSMENT**, n. in *OE.*, circumlocution; indirect way.—SYN. of ‘encompass’: to environ; include; invest; circumscribe; confine; bound.

ENCORE, int. or n. áng'kōr [F. *encore*; OF. *ancore*—from mid. L. *hanc-horam*, this time, another time]: again; once more; a repetition of the same: V. to call for the repetition of a part of a performance. **ENCO'RING**, imp.

ENCOUNTER—ENCRINITE.

ENCORED', pp. *-kōrd'*.—Encore is not thus used by the French themselves; their cry is *Bis* (twice).

ENCOUNTER, n. *ĕn-koun'tér* [F. *encontre*, an encounter —from *en*, in; F. *contre*, L. *contra*, against]: a sudden or accidental meeting of two or more persons; a combat; a fight; a battle: V. to meet suddenly or unexpectedly; to meet in opposition or in a hostile manner; to resist and oppose; to fight. ENCOU'NTERING, imp. ENCOU'NTERED, pp. *-térd*.—SYN. of 'encounter, n.': attack; contest; conflict; assault; skirmish; interview; meeting.

ENCOURAGE, v. *ĕn-kür'āj* [F. *encourager*, to animate —from *en*, in; F. *cœur*, L. *cor*, the heart (see COURAGE)]: to inspire with courage; to increase confidence of success; to embolden; to animate; to support; to cheer. ENCOURAGING, imp.: ADJ. exciting courage; inspiring with hope; cheering. ENCOUR'AGED, pp. *-ĭjd*. ENCOUR'AGEMENT, n. *-ăj-mĕnt* [F.]: incitement to action or to practice; that which serves to incite to, or promote, any undertaking; favor; profit; countenance. ENCOUR'AGINGLY, ad. *-lī*.—SYN. of 'encourage': to enliven; exhilarate; comfort; console; solace; inspirit; incite; urge; impel; stimulate; instigate; countenance; sanction; promote; strengthen; forward; advance.

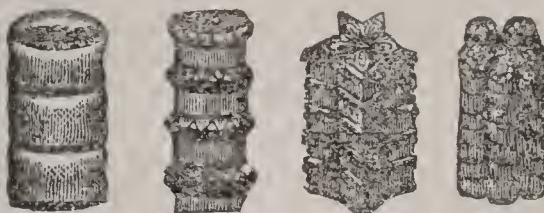
ENCRATITES, n. *ĕn'kra-tīts* [Gr. *engkratēs*, holding fast, master of oneself]: in *chh. hist.*, a rigid sect which arose in the 2d c. It was formed by Tatian, an Assyrian, and a follower of Justin Martyr. Agreeing in most respects with the general church, he is nevertheless accused of corrupting the faith by adding to it a mixture of the oriental philosophy. He insisted on the essentially evil character of matter, and the consequent necessity of mortifying the body. He lived in celibacy, fasted rigorously, and used water instead of wine in the Lord's Supper. In addition to the name Encratites (Abstainers), he and his followers were called Hydroparastatae (Water-drinkers), and Apotactatae (Renouncers).—*Encratites* was also a name assumed in the 4th c. by certain Manicheans (in no way connected with Tatian), to shield them from the penal laws directed against the sect to which they belonged.

ENCRIMSON, v. *ĕn-krim'zn* [*en*, to make, and *crimson*]: to give a crimson color to. ENCRIM'SONED, a. *-znd*, having a crimson color.

ENCRINITE, n. *ĕn'kri-nīt* [Gr. *en*, in; *krinon*, a lily]: an extensive and chiefly fossil group of echinoderms, characterized by their long many-jointed stalks, surmounted by lily-shaped bodies or receptacles; the stone-lily. ENCRINAL, a. *ĕn-kri'năl*, or ENCRIN'IC, a. *-krin'ik*, and ENCRINIT'IC, a. *-kri-nīt'ik*, also ENCRINITAL, relating to or containing encrinites; applied to some carboniferous limestones almost entirely composed of fossil skeletons of encrinites, found in extensive beds in New York, in the Hamilton and Helderberg groups.

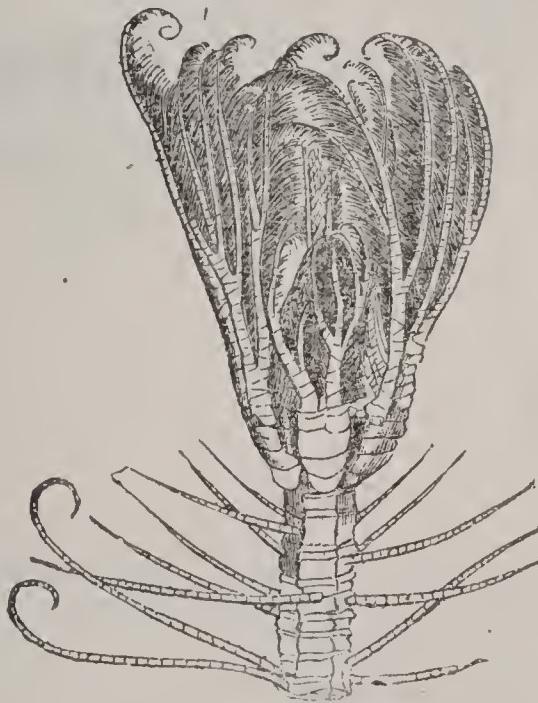
ENCRINITES.

ENCRINITES, *ĕn'kri-nīts*: the old name for the fossil Crinoidea, a family of Echinodermata (q.v.). The popular name, *Stone Lilies*, is given to the numerous fossil species, from the resemblance to the lily which many of them present when the rays are closed; hence also the name Crinoidea.



Encrinite Stems (Mountain Limestone).

Crinoids are characterized by having their bodies supported, during the whole or part of their existence, on a longer or shorter jointed calcareous stem. The stem is attached either by the expanded base, or by jointed processes, to the rocky bed of the sea, or perhaps, in some cases, to floating bodies, like barnacles. Occasionally, numerous root like side arms are sent out from the base of the stem to strengthen and support it; and in some species, as in the recent *Pentacrinus*, the column throughout its length is furnished with axillary



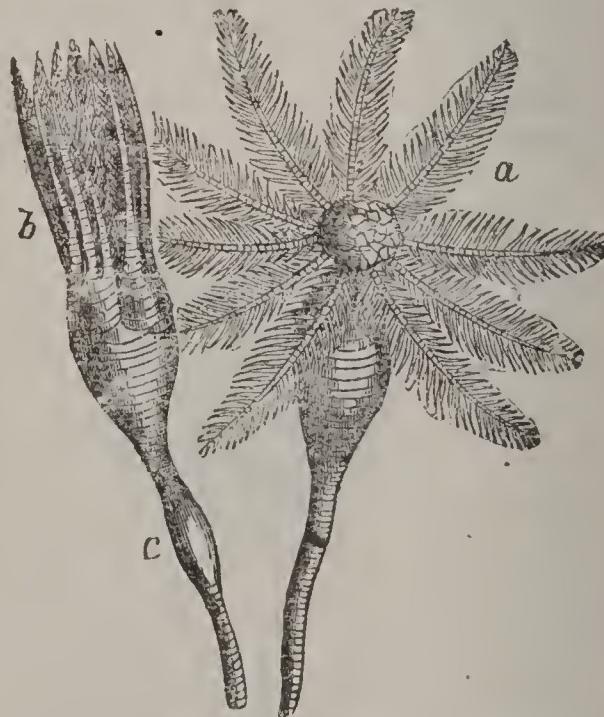
Pentacrinus Caput Medusæ.

side-arms. The stem is round or five-sided; in one genus only is it elliptical. It is composed of a number of joints, perforated in the centre, for the passage of a soft portion of the animal, and beautifully sculptured on the articulating surfaces. The body is cup-shaped, and composed of many-sided plates on the under surface, to the centre of which the stalk is attached, while the upper surface is covered with a coriaceous skin, protected by many small plates. On this was situated the mouth, frequently proboscisidiform, and

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near it was the anal orifice—the alimentary canal being turned upon itself, as in the Bryozoa. The arms spring from the edges of the cup. They are five in number at their origin, but, with few exceptions, speedily divide and subdivide dichotomously. The arms are composed of articulated calcareous joints, similar to those of the stems. Each joint is furnished with two slender-jointed appendages or cirri, for capturing prey which consisted of mollusca and other small animals. The number of joints in some species is amazing. Dr. Buckland calculated that *Pentacrinus Briareus*, consists of at least 150,000; and ‘as each joint,’ according to Carpenter, ‘was furnished with at least two bundles of muscular fibre—one for its extension, the other for its contraction—we have 300,000 such in the body of a single *Pentacrinus*, an amount of muscular apparatus far exceeding anything that has elsewhere been observed in the animal kingdom.’

Of 8 genera living, 5 are always stalked. *Pentacrinus*



Apio Crinites Rotundus (from Buckland's *Bridgewater Treatise*)
a, expanded; b, closed; c, showing where the stem has been injured,
and repaired by calcareous secretion.

Caput Medusæ of permanently stalked E. lives in tropic seas. It is a native of the W. Indian seas.

The family commenced its existence with the earliest sedimentary deposits. 73 genera have been described, containing upward of 300 species, two-thirds of which are found only in Paleozoic rocks. The most ancient E. have nearly all round stems, the few that are five-sided having the articulated surface of the joints simply radiated, and not complexly sculptured as in *Pentacrinus*, the type of a division of the order which appears first in the Lias. The earlier seas literally swarmed with these animals. ‘We

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may judge,' says Dr. Buckland, 'of the degree to which the individual crinoids multiplied among the first inhabitants of the sea, from the countless myriads of their petrified remains which fill so many limestone beds of the older formations, and compose vast strata of entrochal marble, extending over large tracts of country in n. Europe and N. America. The substance of this marble is often almost as entirely made up of the petrified bones of Encrinites, as a corn-rick is composed of straws.' See CRINOIDS: PENTACRINUS.

ENCRINURUS, n. *ěn-kři-nūr'üs*: in paleon., typical genus of *Encrinuridæ*, family of Trilobites, occurring in the Upper and Middle Silurians.

ENCROACH, v. *ěn-krōch'* [F. *en*, in; *accrocher*, to hook on to—from *croc*, a hook]: to invade rights or possessions of another, to take possession of what belongs to another gradually or by stealth; to pass proper bounds; to intrude. ENCROACH'ING, imp.: ADJ. tending or apt to encroach. ENCROACHED', pp. *-krōcht'*. ENCROACH'ER, n. one who. ENCROACH'INGLY, ad. *-li*. ENCROACH'MENT, n. the seizing stealthily a part of the rights or possessions of another; unlawful advance upon the rights of another; invasion; inroad.—SYN. of 'encroach': to invade; infringe; trespass.

ENCRUST: see INCRUST.

ENCUMBER, v. *ěn-kǔm'bér* [F. *encombrer*, to hinder, to perplex—from mid. L. *cumbra*, a heap: Dut. *komber*, loss, difficulty: Ger. *kummer*, trouble, rubbish]: to burden with a load; to clog or impede motion with a load; to perplex or embarrass; to load an estate with debt. ENCUM'BERING, imp. ENCUM'BERED, pp. *-bérđ*, impeded; loaded with debts, as an estate. ENCUMBERED (or INCUMBERED) ESTATES COURTS, in Britain: see IRELAND. ENCUM'BRANCE (or INCUMBRANCE), n. *-brāns*, anything which impedes motion; load; hindrance; impediment; claim on an estate, as for money or service: see HERITABLE SECURITY: MORTGAGE: LIEN: IRELAND (*Encumbered Estates Courts*). ENCUM'BRANCER, n. *-brān-sér*, one who holds an encumbrance on an estate.—SYN. of 'encumbrance': burden; clog; obstruction; check;—of 'encumber': to press; overload; embarrass; hinder; perplex; clog.

ENCYCLICAL, a. *ěn-sík'lí-küł*, or ENCYC'LIC, a. *-lik* [Gr. *engkuklios*, circular—from *en*, in; *kuklos*, a circle: F. *encyclique*]: sent to many persons or places; intended for many, as a letter sent individually to a whole order of men; applied anciently to a letter from a church to other churches generally; and later, to the letter of a primate to his suffragan bishops; but now applied specifically to the letter or circular which, on any important occasion, the pope addresses to the bishops of the Rom. Cath. Church, condemning errors or conveying advice; circular. ENCYCLICA, n. *ěn-sík'lí-kü*, a letter or circular addressed by the pope to bishops on any important occasion.

ENCYCLOPEDIA.

ENCYCLOPEDIA, n., or ENCYCLOPÆDIA, *ĕn-sī'klō-pē-dī-ă*, also CYCLOPEDIA, or CYCLOPÆDIA [F. *encyclopédie*—from Gr. *engkūk'lōpaidei'ă*—from Gr. *en*, in; *kuklos*, a circle; *paideia*, instruction]: a circle of instruction; an alphabetical summary of knowledge. ENCY'CLOPE'DIAN, a. *-pē'dī-ăñ*, embracing the whole circle of learning. ENCY'CLOPE'DIC, a. *-pē'dīk*, pertaining to; also ENCY'CLOPE'DICAL, a. *-pē'dī-kāl*. ENCY'CLOPE'DISM, n. *-pē'dīz̄m*, the state of being encyclopedic in character. ENCY'CLOPE'DIST, n. one who compiles, or assists in compiling, an encyclopedia.—*Encyclopedia* means properly a book or work professing to give information, more or less full, on the whole circle of human knowledge. The Greek words from which it was compounded were used by the Greeks and Romans to signify the circle of instruction through which every free-born youth had to pass before entering public life. That circle embraced particularly grammar, music, geometry, astronomy, and gymnastics, and afterward became the ‘seven liberal arts’ of the middle ages. The compound name Encyclopedia appears to have been unknown to the Greeks, also to the Latin writers of the classic period; and there is no evidence that either Greeks or Romans ever applied the words, single or compounded, to designate a book. The short form *Cycloedia* is more remote from classical authority than Encyclopedia.

Encyclopedias, in the modern sense of the word, are usually alphabetical; but sometimes the arrangement is ‘rational,’ i.e., according to the natural relations of the subjects. An alphabetical Encyclopedia is a Dictionary of Universal Knowledge. Besides this, its proper meaning, the name Encyclopedia is often applied—less properly perhaps—to alphabetical works whose scope is limited to a particular branch—works differing in no respect from Dictionaries, Gazetteers, etc.: see DICTIONARY. As all works of this kind, now a large and increasing section of literature in every language, have so far a common character with Encyclopedias proper, some account of the whole class may here be given.

They may be arranged in three divisions: 1. The earlier works of this kind, having, for the most part, merely an encyclopedic character, i.e., embracing a large range of subjects, without distinctly aiming at universality; 2. Encyclopedias proper, which treat of the whole circle of human knowledge; 3. Books professedly confined to a definite department of knowledge, whether under the name of encyclopedia, dictionary, gazetteer, or other title. As books of this class profess to touch on every important point that comes within their scope, they may be considered as encyclopedic in a limited sense. In the following sketch, the somewhat indeterminate distinction between the first and second of those classes, is not strictly adhered to when it would interfere with the chronological sequence.

1. The earliest work of an encyclopedic character is generally ascribed to Speusippus, disciple of Plato. The great collections of Varro (*Rerum Humanarum et Divinarum Antiquitates* and *Disciplinarum libri ix.*), of the elder Pliny

ENCYCLOPEDIA.

(*Historia Naturalis*), of Stobæus, of Suidas, of Isidorus (*the Origines*), and of Capella, belong to the same class, but they exhibit no plan, and are only confused accumulations of treatises of the then known arts and sciences. Vincent of Beauvais (1264) surpassed them all. He gathered together with wonderful diligence the entire knowledge of the middle ages in three comprehensive works, *Speculum Historiale*, *Speculum Naturale*, and *Speculum Doctrinale*, to which soon afterward an unknown hand added *Speculum Morale*. But these, as well as the similar compilations in the later mediæval period under the title of *Summa*, or *Speculum* (*Mirror*), are marked throughout by a lack of philosophic spirit. Perhaps the nearest approach to the modern encyclopedia by an ancient writer, dates two centuries earlier than the time of Beauvais. In the 10th c. lived Alfarabius, the ornament of the school of Bagdad, who wrote an encyclopedic collection of knowledge, remarkable for grasp and completeness, still in ms. in the Escorial of Spain. Among the earliest and most noted of modern encyclopedias was that of Johanna Heinrich Alsted, or Alstedius, which appeared in Germany, 2 vols. 1630. It consisted of 35 books, of which the first four contained an explanation of the nature of the rest. Then followed six on philology, ten on speculative, and four on practical philosophy; three on theology, jurisprudence, and medicine; three on the mechanical arts; and five on history, chronology, and miscellaneous topics. Two important French works belong to this century—the one is Louis Moreri's *Grand Dictionnaire Historique et Critique*, of which the first edition appeared at Paris 1673, and the last 1759; the other, Peter Bayle's famous *Dictionnaire Historique et Critique*, 4 vols. Rotterdam 1697. The first encyclopedic dictionary, so far as known, appeared in Germany as the *Lexicon Universale* of Hoffmann, 2 vols. Basel 1677. Some time afterward appeared in France Thomas Corneille's *Dictionnaire des Arts et des Sciences*, 2 vols. (Paris 1694). Dictionaries limited to the explanation of technical terms had long been common throughout Europe; but previous to Hoffmann's work, no attempt had been made to bring the whole body of science and art under the lexicographic form. A highly successful attempt identical in kind, and attributable in idea, it may be, to the German work just alluded to, was the *Lexicon Technicum* of Dr. Harris, 2 vols. folio (London 1710), which may fairly be regarded as the parent of all the dictionaries of arts and sciences since in England. The *Cyclopædia* of Ephraim Chambers, published 1728, two very large folio vols., presents the next marked advance in the construction of encyclopedic dictionaries. This was brought out with considerable claims to originality of arrangement. The author endeavored to communicate to his alphabetical materials something of the interest of a 'continuous discourse,' by an elaborate system of cross-references. Another peculiarity was, that its author, in the details of mathematical and physical science, gave only conclusions and not processes of demonstration. It was long a very popular work. The

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largest and most comprehensive of the successors to Hoffmann's book in Germany was Zedler's *Universal Lexicon*, 64 vols. (Leip. 1732-50). In point of comprehensiveness, this work should be classed with the encyclopedias proper, there being almost nothing then known that may not be found in it. Perhaps the strongest impulse, if not in all respects the best, communicated by the successful attempt of Ephraim Chambers, was given to the French mind through D'Alembert and Diderot. Their *Encyclopédie* was really, though not professedly, founded upon E. Chambers's book, which an Englishman named Mills had translated 1743-45, though the French version of it never was published. The great French *Encyclopédie* was written by various authors of high literary and philosophical attainments, but of whom nearly all were tainted with the most impracticable revolutionary ideas, besides holding for the most part extremely sceptical opinions. The *Encyclopedists* excluded both biography and history from its scope, yet infused into it more originality, depth, and ability than ever had appeared before within the boards of an encyclopedical dictionary. It appeared at Paris in 28 vols. 1751-72, and was followed by a supplement in five vols. (Amst. 1776-7), and an analytical index in two vols. (Paris 1780). The work was everywhere received with great enthusiasm, and it secured a place in the literary history of the nation for the editors and principal writers, who are ordinarily known as the *Encyclopédistes* of France. They were D'Alembert and Diderot the editors, Rousseau, Grimm, Dumarsais, Voltaire, Baron d'Holbach, and Jancourt. [See La Porte's *Esprit de l'Encyclopédie* (Paris 1768); and Voltaire's *Questions sur l'Encyclopédie* (Paris 1770).] D'Alembert's celebrated preliminary discourse was garbled in various pretentious works of this class published mostly in England; such were Barrow's *New and Universal Dictionary of Arts and Sciences*, 1 vol. folio 1751; and the *Complete Dictionary of Arts and Sciences*, by Croker, Williams, and Clerk, 3 vols. folio 1766. A somewhat better, though rather illogical performance was published by a 'Society of Gentlemen,' 1754 in four 8vo vols., generally known as *Owen's Dictionary*, from the name of its publisher. The first rude outline of the ponderous and solid *Encyclopædia Britannica* was laid down in 1771, in three vols., but it was nothing more than a dictionary of arts and sciences; it had not attained to its subsequent universality.

2. The first encyclopedia proper that demands attention is the *Encyclopædia Britannica*, of which the 2d comparatively complete edition, containing biographical and historical articles, appeared in 10 vols. 1776-83; the 3d ed. was completed in 18 vols. 1797; the 4th ed., 20 vols., 1810; the 5th and 6th editions, and supplements, in 6 vols., appeared 1815-24; the 7th ed. 21 vols., 1830-42; the 8th ed. 21 vols., 1852-60; and the 9th ed., 24 vols., 1875-88. The method pursued by this work, while thoroughly alphabetical, consists in a combination of the systematic and the particular. In few instances is any science broken up

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into fractional parts; nearly all the sciences are given in treatises as they severally occur in the order of the alphabet. In some cases, however, where obscurity might result from such a plan, the other method is adopted. A marked feature of this work, is the number of complete treatises and dissertations by men of European fame. From first to last, this encyclopedia has been executed and published in Edinburgh, the literary reputation of which it has helped in no small degree to increase. The next encyclopedia to be noticed is the *Encyclopédie Méthodique par Ordre des Matières*, begun 1782, and not finished till 1832. It extends to 166½ vols. of text, with 51 'parties,' containing 6,439 plates. Each subject is treated in a separate vol. or series of vols., so that the work is a collection of separate dictionaries, more extensive than any encyclopedic work that has yet appeared. A work of higher scientific value, however, and of even more varied nature, has been in progress for nearly half a century in Germany, undertaken originally by Professors Ersch and Gruber 1818, and which has since continued to appear, in three several sections of the alphabet, till the present time. There have already appeared of this great *Allgemeine Encyclopädie der Wissenschaften und Künste* some 150 vols. In 1802, Dr. Abraham Rees projected an extended and improved edition of Ephraim Chambers's *Cyclopædia*, which was completed in 45 vols., 1819. The system of cross-references peculiar to E. Chambers is very effectually carried out in this book; but besides including a great accession of historical and biographical detail, it contained a large number of papers, prepared by competent writers, on subjects with which their study and work had rendered them familiar. Another work of considerable merit, which began to appear 1810, was Brewster's *Edinburgh Encyclopædia* edited by the late Sir David Brewster, and completed in 18 vols. 1830. In 1812, a great impetus was given to encyclopedic publications by the appearance of the *Conversations-Lexikon* of F. A. Brockhaus of Leipsic. The 13th ed. (15 vols.) appeared 1882–87; the 14th (illustrated ed.) began to appear 1894. (Meyer's and Pierer's *Conversations-Lexika* also are standard German works.) Brockhaus's has been translated into nearly all the civilized languages of Europe, no fewer than four English works of the kind being professedly founded on it: The *Encyclopædia Americana* (14 vols. 1829–46); the *New American Cyclopædia* (16 vols. New York, 1858–63), of which a new ed. under the title *American Cyclopædia* appeared 1873–76; the *Popular Encyclopædia* (6 vols. Glas., new ed. 1883); and *Chambers's Encyclopædia* (10 vols. Edin. 1860–68; revised ed. 1874–86; new revised ed. completed in 1892): the last is a substantially new work, following in its construction the admirable plan of the *Conversations-Lexikon*, but making use of its valuable matter only so far as it is found suitable. This work has found great popular favor, and has been republished in various forms (some with large additions) in the United States.

The next encyclopedic work after the *Conversations-Lexi-*

ENCYCLOPEDIA.

kon, was one projected according to an original philosophic plan by Samuel Taylor Coleridge, 1818, and finished 1845, in 30 vols. This *Encyclopædia Metropolitana* was arranged in four divisions: 1st, the pure sciences; 2d, the mixed and applied sciences; 3d, biography and history; and 4th, miscellaneous (strangely including geographical) and lexicographic articles. The contributions to the first two divisions were written by persons of recognized ability, and they have nearly all been published separately in 8vo vols. since the *Metropolitana* appeared. If the book had any fault, it was that the plan of it was too rigidly philosophical, and therefore not adapted to be consulted in dictionary fashion; for though in one sense the alphabetic arrangement, by its jumble of subjects, is most heterogeneous and irrational, it recommends itself to popular acceptance by its extreme simplicity; and in point of fact, no encyclopedia has ever been thoroughly popular that has not been executed on the plan of a single alphabet, in which all subjects, however various, are included. Next appeared the *Penny Cyclopædia* of the Soc. for the Diffusion of Useful Knowledge, begun 1833, completed 1843, 28 vols. This work was perhaps, at the time it appeared, the most useful and convenient, for general consultation, of any encyclopedical treatise that had ever been issued. The *English Cyclopædia* is founded on the copyright of the *Penny Cyclopædia*, but is rearranged in four great divisions, each given in the order of the alphabet, viz., geography, natural history, biography, and arts and sciences. This publication was begun 1853, and completed 1861 in 22 vols.; a synoptical index appeared 1862, and a supplementary vol. for each division has since been issued (1869-73). Among other publications of this character which have appeared in the present century, are Wilkes's *Encyclopædia Londensis*, 24 vols. 4to (Lond. 1810-29); *Encyclopædia Perthensis*, 23 vols. (Edinburgh 1816); and *London Encyclopædia*, 22 vols. (Lond. 1829). The French have published an *Encyclopédie des Gens du Monde*, 22 vols. 8vo (Par. 1833-44); *Encyclopédie Moderne* (42 vols. 1846-62); *Dictionnaire de la Conversation et de la Lecture* (16 vols. 1854-57); and the *Grande Dictionnaire Universel du XIX^e Siècle*, edited by Larousse, is one of the most important of modern encyclopedic works. The most notable of the German encyclopedias resembling that of Brockhaus, are Meyer's *Conversations-Lexicon*, 15 vols. (1857; 3d ed. 1874-78, with 6 supplemental vols. 1878-84; 4th ed. 1885, etc.); and Pierer's *Universal Lexicon*, 34 vols. (Altenburg, 1840-46; 6th ed., 1875, etc.). In addition are several European encyclopedias, based upon the *Conversations-Lexicon*—such as the *Enciclopedia Española* (Madrid); the *Nuova Encyclopædia Popolare Italiana* (Turin); the *Nordisk Conversations-Lexicon*, 5 vols. (Copenhagen, 1858-63); and the *Svenskt Konversations-Lexikon*, 4 vols. (Stockholm, 1845-51); besides others in Russia, Hungary, the Netherlands, etc.

3. Different in kind are those books that are *dictionaries* or encyclopedias for one branch of knowledge only. Such are the great *Dictionary of National Biography*, edited by

ENCYCLOPEDISTS—END.

Leslie Stephen (begun 1885, and meant to run to 30 vols.); the *Biographie Universelle* (commenced 1811; new ed. 1842–65); Chalmers's *Biographical Dictionary*, 32 vols. (1812–17); the *Dictionnaire des Sciences Médicales*, 60 vols. (Par. 1812–22); *Nouveau Dictionnaire d'Histoire Naturelle*, 36 vols. (Par. 1816–19); F. Cuvier's *Dictionnaire des Sciences Naturelles*, 60 vols. text, 10 vols. plates (1816–45); *Dictionnaire de l'Industrie*, etc., 10 vols. (Par. 1834–41); M'Culloch's *Commercial Dictionary* (1832; last ed., 1882); M'Culloch's *Geographic Dictionary* (1st ed. 1841; new ed. 1866); *Dictionary of Practical Medicine* (Lond. 1866); Chambers's *Cyclopædia of English Literature* (1843; 3d ed. 1876); Spon's *Dictionary of Engineering* (1869–74); Johnston's *Gazetteer* (1850; new ed. 1877); Morton's *Cyclopædia of Agriculture*, 3 vols. (1855); *Nouvelle Biographie Générale* (1855–66); Lippincott's *Gazetteer of the United States* (Philadelphia, last ed. 1882); Allibone's *Dictionary of British and American Authors* (Philadelphia, 1859–71); Ure's *Dictionary of Arts, Manufactures, and Mines* (1839; 7th ed., supp. vol. 1877); Schmid's *Encyclopædia des Erziehungs und Unterrichtswesen* (1859–75). Also should be noted the dictionaries of Dr. William Smith, viz., *Dictionary of Greek and Roman Biography and Mythology*, 3 vols. (1843–48; new ed. 1849–51); *Dictionary of Greek and Roman Antiquities*, 2d ed. (1849); *Dictionary of Greek and Roman Geography*, 2 vols. (1854–57); *Dictionary of the Bible*, 3 vols. (1860–63); and *Dictionary of Christian Antiquities* (1875–80); *Dictionary of Christian Biography* (4 vols.). The greatest theological E. is *McClintock and Strong's Cyclopædia of Biblical, Theological, and Ecclesiastical Literature* (10 vols. 1877–1881); and the chief foreign work is Herzog's *Realencyklopädie der Theologischen Wissenschaften* (20 vols.), translated into English, ably re-edited, and pub. (with additions) as the *Schaff-Herzog Encyc. of Relig. Knowledge*.

Recently a valuable improvement in the structure of great cyclopedic works of reference has been undertaken in the combination under one alphabet of a cyclopedia and a dictionary. Each of the two elements of such a work is distinctly helpful to the other—indeed evidently needful to the other for purposes of complete presentation of any subject, as well as for convenient popular consultation. See DICTIONARY.

ENCYCLOPE'DISTS: see ENCYCLOPEDIA.

ENCYST, v. ēn-sist' [Gr. *en*, in; *kustis*, the bladder, a bag]: to inclose in a cyst or vesicle. ENCYST'ED, a. inclosed in a bag, sac, or cyst; consisting of cysts.

END, n. ēnd [Goth. *andēis*; Skr. *anta*, end, death: AS. *ende*]: the extreme point; the extremity or last part; the conclusion or close; last or ultimate state; limit; close of life; issue or result; object aimed at, as end in view: V. to finish; to terminate; to conclude; to destroy; to be finished; to cease. END'ING, imp.: N. termination; conclusion. END'ED, pp. END'LESS, a. without end; interminable; unlimited; perpetual. END'LESSLY, ad. -li. END'LESSNESS, n. THE ENDS OF THE EARTH, the remotest parts. END ALL, a

END.

complete termination. END'WISE, ad. -*wiz* [end ways]: on end; erectly; with the end forward. END'MOST, a. remotest; at the extreme end. END'BULBS, n. in *anat.*, bulbous swellings, constituting the termination of some sensory nerves. END'PLATES, n. in *anat.*, expansions terminating the nerves of voluntary muscles. END'SHAKE, n. a certain freedom of endwise motion of a spindle or arbor, which has bearings at each end, so that the shoulders of the gudgeons or pivots (as in a watch), shall not bear against the journal-boxes or plate. END-STONE, n. one of the plates of a watch-jewel against which the pivot abuts. ON END, upright or erect with its whole length. TO PUT AN END TO, to settle; to finish; to destroy completely.—SYN. of 'end, n.': close; finish; last; conclusion; termination; extremity; finality; effect; issue; result; consequence; extermination; object; purpose; aim; drift; remnant; fragment;—of 'endless': eternal; everlasting; infinite; perpetual, incessant; continual; uninterrupted.

END, in Ethics: 'the thing aimed at,' the object, purpose, or goal of human action. There is a fundamental contrast between Science and Art, Knowledge and Practice. Science, or Knowledge, embraces the general order of the universe, and states that order in the form by which we can take in as much as possible in one view; it is the fullest intellectual comprehension of the phenomena of nature that the mind can attain to. Art, or Practice, on the other hand, selects and appropriates certain items of knowledge, so as to subserve some useful purpose, some exigency of human life. Thus Agriculture, Navigation, Law, Politics, Education, all are branches of Practice; they involve knowledge, but in strict subordination to their several purposes. The navigator studies Astronomy, not with a view to enlighten his understanding as to the mysteries of the solar system and the starry sphere, but with a view to the guidance of his course in the sea. In short, to an Art (the word is not here used in the narrow sense of a Fine Art), or a department of Practice, belongs in the first place the consideration of the *end*. Every Art has its end, which is its distinction from every other art. In most of the arts, the end is clear and unmistakable: we all know what is expected of a builder, a soldier, or a judge; the only question is how to obtain the knowledge requisite for adequately performing each separate function. But there are some departments where the end itself is not agreed upon, which casts a peculiar difficulty on the practice. Thus, in discussing civilization (q.v.) the fact comes into view that the end of the whole mechanism of Human Society, including Politics, etc., is differently viewed by different minds. But it is in the one special Department of Morality that the consideration of the end is of most vital consequence. This feature of the ethical problem has been very little adverted to in modern discussions, while the ancient philosophers kept it more prominently before them. Aristotle begins his *Ethics* by remarking that every art aims at some good; most arts, as medicine, ship-building, generalship, having limited or partial ends; while some compre-

ENDAMAGE—ENDECAGYNOUS.

hend much wider ends than others—the largest end of all being the good of mankind collectively. Hence he goes on to inquire what is the highest good of man, and finds that happiness is neither Pleasure, nor Honor, nor Virtue (by itself), nor Wealth, but that it is ‘an energy of the soul according to virtue;’ activity, in opposition to Oriental notions of luxurious repose, being an essential in his eyes. He has next, therefore, to inquire what ‘virtue’ is, according to which a man must employ his activity—a question of no easy solution. Still, the discussion brings out the one fact, that Morality is a branch of Practice, but unlike most arts in this, that the end has been found peculiarly difficult to determine precisely. Accordingly, it is necessary to have in connection with it a set of discussions, called by Mr. J. S. Mill (*Logic*, concluding chapter) Teleology, or the Doctrine of Ends, corresponding to what the German metaphysicians have termed the Principles of Practical Reason. The various theories of Moral Obligations differ in their statement of the end of Morality: according to one, it is the self interest of the individual; according to another, the interest of mankind on the whole; according to others, conformity to the eternal Divine pattern of purpose and action—the development into action of a universal love toward God and toward all beings. A prevalent theory—which, so far as by its vagueness it does not elude all tracing, may perhaps be embraced as an element in some of the other theories—is the harmonizing with a certain inward sentiment called the Moral Sense. See ETHICS.

ENDAMAGE, v. *ĕn-dăm'āj* [*en*, and *damage*: F. *endomager*, to damage]: to injure; to do mischief.

ENDANGER, v. *ĕn-dăñ'jér* [*en*, and *danger*]: to put in hazard; to peril; to expose to injury or loss. **ENDAN'GERING**, imp. **ENDAN'GERED**, pp. *-jĕrd*.

ENDEAR, v. *ĕn-dĕr'* [*en*, to make, and *dear*]: to make dear; to make more beloved. **ENDEAR'ING**, imp.: ADJ. having a tendency to make dear or beloved. **ENDEARED'**, pp. *-dĕrd'*: ADJ. made beloved or more beloved. **ENDEAR'MENT**, n. state of being beloved; the cause of love; that which endears; tenderness; affection: N. PLU. caresses.

ENDEAVOR, v. *ĕn-dĕv'ĕr* [F. *en devoir*, in duty—from *en*, in; *devoir*, to owe, to be bound; *devoire*, endeavor]: to make it our duty to do a thing; to exert strength either of body or mind for the accomplishment of a purpose; to attempt; to try: N. an exertion of strength, physical or mental, toward some end; effort; an attempt. *I shall do my endeavor*, implying *duty*, means, *I shall make an effort*. **ENDEAV'ORING**, imp. **ENDEAV'ORED**, pp. *-érd*.—SYN. of ‘endeavor, v.’: to essay; struggle; strive; aim; exert.

ENDECAGON, n. *ĕn-dĕk'ă-gōn* [Gr. *hendēkă*, eleven; *gōnīă*, an angle]: a plane figure having eleven sides and eleven angles.

ENDECAGYNOUS, a. *ĕn-dĕk-aj'ĭn-ŭs* [Gr. *hendeka*, eleven, and *gūnē*, woman]: in bot., having eleven petals,

ENDECAPHYLLOUS—ENDEMIC.

ENDECAPHYLLOUS, a *ěn-děk-a-fil'lüs* [Gr. *hendeka*, eleven; *phullon*, leaf]: having eleven leaflets.

ENDEICTIC, a. *ěn-dīk'tīk* [Gr. *endeiktikos*, demonstrating—from *endeiknumi*, to show]: showing; exhibiting displaying; as, an *endeictic* dialogue, one which displays skill.

ENDEIXIS, n. *ěn-dīks'is* [Gr. *endeiknumi*, to show]: in *med.*, a showing, displaying, or exhibiting; applied to such symptoms or appearances in a disease as point to the proper remedies to be applied.

ENDELLIONITE: see BOURNONITE

ENDEMIC, a. *ěn-děm'ik*, or **ENDEM'ICAL**, a. *-i-kăl* [F. *endémique*—from Gr. *endēmīos*—from *en*, on; *dēmōs*, people]: peculiar to a district or to a certain class of persons—applied to a prevalent disease arising from local causes, as bad air or water: N. a disease prevailing in a particular locality or among a particular class of persons. **ENDEMICAL**, ad. *-li*.—*Endemic* is applied to diseases which affect numbers of people simultaneously, but so as to show a connection with localities as well as with their inhabitants. Endemic diseases are usually spoken of as distinguished from epidemic (q.v.) and sporadic (q.v.); the first term indicating that a disease infests habitually the population within certain geographical limits, also that it is not characterized by being transferred or communicated beyond those limits; while a disease is termed epidemic if it is transmitted without reference to locality; and sporadic if it occurs in isolated instances only. The theory, accordingly, of endemic diseases is, that they are in some way or other connected with the soil—the result of terrestrial influences, or *miasms*—of poisons generated within the earth, or near its surface, and diffused through the air, so as to be weakened in proportion to the distance from the source of the poison. Such poisons are always observed to be more virulent in summer than in winter—more dangerous at night, when the vapors are concentrated on the surface of the soil, than in the daytime—more abundant in the plains, and in close confined places, than at a certain degree of elevation—more easily carried in the direction of the wind than in the opposite; and very often arrested altogether by water, or by a belt of forest or other luxuriant vegetation. In all these particulars, *endemic* are different from *epidemic* diseases, which bear no very obvious relation to the soil, and are not observed to be considerably modified either by the prevailing winds or the period of the day or night at which exposure to their influence takes place. The most marked type of an endemic disease is ague (q.v.) or intermittent fever, which has all the habits mentioned above, and is to so marked a degree a denizen of particular tracts of country as to lead to their being in some instances almost depopulated. Many places in Italy are a prey to the *aria cattiva* or *malaria*, as it is popularly called; and hence, no doubt, even more than for protection from human foes, the custom so prevalent in that country of building the villages on the tops of hills, so as to secure immu-

ENDERBY LAND—ENDERON.

nity from the poisonous vapors raised by the solar heat from the plains lying on either side at the base of the Apennines. Terrestrial *miasms*, or such poisons as generate endemic diseases, are found usually in the neighborhood of marshy flats, or of uncultivated tracts of land at the confluence of rivers, or where a *delta*, or a wide channel subject to overflow, is formed at the upper end of a lake. In proportion, too, as the heat of the sun is greater, the tendency to malarious emanations is increased; and in the tropics, accordingly, large tracts of jungle and forest are often rendered absolutely uninhabitable and almost impassable at certain seasons, because of the invisible and odorless germs of intermittent, remittent, and even continued fevers (q.v.), which are more fatal and unmanageable than the most terrible epidemic pestilences to those exposed to them. Such diseases are almost always sudden in their mode of attack, and they indicate the range of their influence by the number of persons attacked; but they are wholly free in most cases from the suspicion of communication by contagion (q.v.), so frequent in the case of epidemic diseases. The precise nature of the malarious poison has never yet been discovered with any approach to exactness. It is known, however, to be almost invariably checked by drainage and cultivation of the soil; and hence many places in Europe, formerly very productive of endemic diseases, have now ceased to be so, as in the case of the Tuscan Maremma, and some parts of Kent and Essex, in England, and of the Lothians in Scotland. In the U.S., endemic diseases prevail in the warm season and in autumn, in certain regions, particularly in the valleys of large rivers. Formerly, they were grievously common in the newly settled western and southwestern states; many of these localities have now been rendered more healthful by increase of cultivation of the soil. See **MIASMA**.

ENDERBY LAND, *ĕn'dér-bĭ*: discovered by Biscoe 1821; lat. $65^{\circ} 57'$ s., long. 47° e. It appeared to the discoverer to be of considerable extent, and was closely bound by field ice, but owing to stress of weather and the extreme cold, it could not be approached within 20 or 30 m., and Biscoe was unable to say whether the land he discovered was an island or a strip of the antarctic continental coast.

ENDERMIC, a. *ĕn-dér'mik*, or **EN'DERMAT'IC**, a. *-măt'ik* [Gr. *en*, on; *derma*, the skin]: in *med.*, consisting of something to be applied to the skin and to be absorbed by it by way of a remedy for disease. **ENDER'MICALLY**, ad. *-lī*.—The endermic method consists in raising a blister by the ordinary process, opening it by a small puncture—not at the lowest point of the bladder of the blister—gently pressing out the fluid contents, and then injecting a medicinal solution, by a small syringe, through the puncture into the emptied sac; or if the medicine is in the form of powder, it may be scattered over the raw surface. This method is now almost entirely superseded by the hypodermic method: see **HYPODERMIC INJECTION**.

ENDERON, n. *ĕn'dér-ōn* [Gr. *en*, in; *dēros*, skin]: in

ENDICOTT—ENDLICHER.

zool., the inner of the two layers of that part of the skin called ‘ectoderm’ or ‘epidermis’: see ECDERON.

ENDICOTT, *ĕn'di-kot*, JOHN: 1589–1665, Mar. 15; b. Dorchester, England: colonial gov. of Mass. He came to America to take charge of the Naumkeag, or Salem, plantation of the Mass. Company, 1628, became gov. of Loudon’s plantation 1629, cut the red cross from the royal colors because it savored of popery to him, and was removed and disqualified to hold office for a year. In 1636 he conducted an expedition against the Block Island and Pequot Indians, and his severities then were alleged as the cause of the subsequent Pequot war. He was dep. gov. of Mass. 1641–44, 50, and 54, and gov. 1644, 49, 51–54, and 55–65; and became sergt.maj.gen. 1645, and pres. of the colonial commissioners 1685. He rigidly enforced the laws; was bitterly opposed to popery, to episcopacy, and to Quakers; executed four Quakers for disobedience of the law of banishment; and aimed at what, according to the intolerance of all parties at that time, he considered a pure church and the highest welfare of the colony.

ENDIRONS, n. plu. *ĕnd'irnz* [*end*, and *irons*]: in prov. Eng. and *OE.*, two movable iron plates employed to contract the capacity of the fireplace or grate: sometimes another spelling of ANDIRONS, which see.

ENDIVE, n. *ĕn'div* [F. *endive*, a salad—from L. *intubum* or *intybum*, chicory], (*Cichorium Endivia*): garden plant from e. Asia, cultivated for fall and winter salad, and for flavoring soups; in restaurants called usually by its French name, *Chicoree*. It may be sown where the plants are to stand, or in a bed from which to be transplanted. The plants should be a foot apart each way. For early use seed may be sown at the middle of April; for the main crop it should be put in at intervals June 15–Aug. 1. When the plants are grown the tips of the leaves should be tied in a bunch. By this means the inner leaves will be blanched, and their quality as well as appearance greatly improved. For this process from two to four weeks will be required. The leaves should be perfectly dry, and only enough to last two or three weeks should be tied at once. Blanching can be effected also by covering with boards or banking with earth. It can be kept for winter use by packing the roots in a dry cellar. The Green Curled E. is one of the best varieties.

ENDLICHER, *ĕnt'lîch-ĕr*, STEPHEN LADISLAS: 1804, June 24; b. Pressburg in Hungary: botanist. He was educated in his native town, and in Pesth, and Vienna, and then entered the priesthood, which he, however, abandoned in a few years. In 1827, he commenced his botanical and linguistic studies, and in the following year he was placed at the head of the imperial library at Vienna. In 1836, he was appointed keeper of the museum of natural history at Vienna, and in 1840 he became prof. of botany in the univ., and director of the botanic gardens. E. was much disturbed by the turn political events had taken in 1848, fell into a state of gloom, and in 1849, Mar., put an

ENDOCARDIUM—ENDOGEN.

end to his own life. A few of his works are on philological subjects, but the great bulk are botanical, the most important being connected with the systematic arrangement of plants. One of his earliest works was *Flora Posoniensis* (1830); in which he describes the plants growing in the neighborhood of Posen arranged according to the natural system. His most important work, *Genera Plantarum secundum ordines naturales disposita*, appeared 1836–50. In it he follows out with great elaboration the system of natural arrangement. It has had great influence on succeeding botanists, and is still one of the most complete works upon systematic botany. Among his works are: *Prodromus Floræ Norfolkicæ* (1833); *Iconographia Generum Plantarum* (1838); *Mantissa Botanica* (1843); *Mantissa Botanica Altera* (1843); *Grundzüge der Botanik*, written in conjunction with Franz Unger (1843); etc.

ENDOCARDIUM, n. ēn'dō-kár'di-ūm [Gr. *endon*, within; *kardia*, the heart]: the membrane lining the interior of the heart. **EN'DOCAR'DIAL**, a. -āl, pertaining to. **EN'DOCARDITIS**, n. -dī'tis, inflammation of the lining membrane of the heart, resulting in the deposit of fibrine upon the valves: see HEART, DISEASES OF.

ENDOCARP, n. ēn'dō-kár'p [Gr. *endon*, within; *karpos*, fruit]: in *bot.*, the inner layer of the pericarp or wall of the seed-vessel, forming the membrane which lines the cavity containing the seeds, as in the apple; the stone or shell which incloses the seed, as in the plum.

ENDOCARPON, n. ēn dō-kár'pon [so named because the receptacles are deeply imbedded in the frond]: type of the family *Endocarpidae*, genus of lichens of the order *Parmeliaceæ* of which *Parmelia* is the type.

ENDOCHORION, n. ēn-dō-kōr'i-on [Gr. *endon*, within; *chorion*]: in *anat.*, the vascular layer of the allantois.

ENDOCHROA, n. ēn-dō-krō'a [Gr. *endon*, within; *chroa*, skin]: in *bot.*, supposed interior layer of the cuticle.

ENDOCHROME, n. ēn'dō-krōm [Gr. *endon*, within; *chrōmā*, color]: in *bot.*, the coloring matter which in lower orders of plants fills vegetable cells, exclusive of the green; a modification of chlorophyl which in the higher classes of plants gives green color to the leaves. Chlorophyl, by its autumnal change of color, may be said to become endochrome.

ENDOCYST, n. ēn'dō-sist [Gr. *endon*, within; *kustis*, a bag or cyst]: in *zool.*, the inner membrane or integumentary layer of a polyzoon.

ENDODERM, n. ēn'dō-dérm [Gr. *endon*, within; *derma*, skin]: in *zool.*, the inner or lower of the two layers of cells into which the blastoderm is divided after the completion of the segmenting process. **ENDODERMIC**, a. ēn'dō-dérm'ik, of or belonging to the endoderm: see ECTODERM.

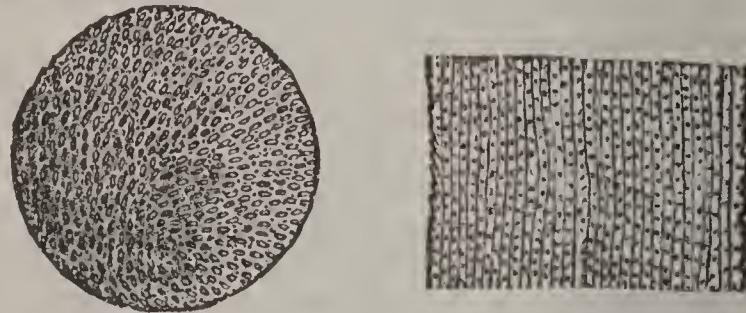
ENDOGAMY, n. ēn-dōg'ā-mī [Gr. *endon*, within; *gamos*, marriage]: the practice of forbidding marriage other than within a tribe.

ENDOGEN, n. ēn'dō-jēn. **EN'DOGENS**, n. plu. -jēns [Gr.

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endon, within; *gennāō*, I produce] in *bot.*, that division of the vegetable kingdom, as palms, grasses, rushes, and the like, whose growth takes place from within, and not by external concentric layers, as in the *exogens*; rather those plants whose vascular bundles are not arranged concentrically, but scattered in the interior. ENDOGENOUS, a. -ēn-dōjē-nūs, increasing by internal growth. ENDOG'ENITES, n. plu. -nīts, fossil stems and fragments exhibiting the endogenous structure. Note.—The term ENDOGEN is inaccurate and passing into disuse.

ENDOG'ENOUS PLANTS, or EN'DOGENS: one of the great classes into which the vegetable kingdom is divided, the others receiving the corresponding designations of *Exogenous Plants* and *Acrogenous Plants*. The character from which this designation is derived is found in the structure of the stem, which does not increase in thickness by additional layers on the outside like the *exogenous* stem, familiarly illustrated in all the trees of the colder parts of the colder parts of the world, but receives its additions of woody matter in the interior; and in general does not continue to increase indefinitely in thickness like the *exogenous* stem, but is arrested when a certain thickness has been attained, different in different species, and afterward increases only in length. When a transverse section is made of an endogenous stem, numerous bundles of vessels



Transverse and Vertical Sections of Endogenous Stem

are seen dispersed irregularly in cellular tissue, the younger and softer parts of the stem exhibiting the cellular tissue in greatest proportion, the older and lower parts abounding chiefly in vascular bundles, which are, however, somewhat scattered in the central part of the stem, and are densely aggregated toward the circumference, there, in the palms generally, forming very hard wood, in some of them wood so hard that it cannot be cut with a hatchet. The stems of endogenous plants in the far greater number of cases produce terminal buds only, and not lateral buds, and are therefore unbranched. From the bases of the leaves, definite bundles of vascular tissue converge toward the centre; but these extending downward extend also outward, and thus an interlacing of fibres takes place, which contributes not a little to the strength and compactness of the wood in the lower part of the stem. As the fibres extend downward, they also become attenuated, spiral and porous vessels disappearing, and nothing but the most ligneous substance remaining. It is the hardening of the outer part of

ENDOGENOUS PLANTS.

the stem which arrests its increase in thickness. Endogenous stems have not a distinct *pith*, nor any *medullary rays*. When the central part is soft and pith-like, yet it is not distinctly separated from the surrounding wood, and has no *medullary sheath*. In many endogenous plants, as in the greater number of grasses, the centre of the stem is hollow. This is not the case at first, when the stem begins to grow; and when any cause makes the growth of the stem unusually slow, so that it is much stunted, it remains solid; the fistular character of the stem is the result of its rapid growth, rupturing the cells of the central portion, which finally disappear. Endogenous stems have no *cambium* and no proper *bark*. There is, indeed, a cellular *epidermis*; and there is also within it, and exterior to the hardest woody part of the stem, a comparatively soft layer of a corky substance, called sometimes bark, sometimes *false bark*, which does not separate from the wood below it without leaving myriads of little broken threads, the ends of the fibres which have extended into it from the hardest part of the stem. In those exogenous plants which produce lateral buds and branches, the fibres of the branches on descending to the stem extend on the outside of the proper stem, between its hardest portion and the false bark; and in this way a great thickness is sometimes attained, as in the dragon-tree. In the grasses, a *plexus* of fibres takes place at the nodes, the fibres crossing from one side to the other. Scarcely any tree of temperate or colder climates is endogenous. Almost all the endogenous trees are palms, though a few, as the dragon-tree, belong to other orders. Endogenous plants, however, are numerous in all parts of the world. Among them are many of the plants most useful to mankind, particularly palms and grasses, all the true corn-plants being included among the latter. Nutritious substances are very extensively produced both in the fruit or seed, and in other parts; poisonous products are comparatively rare, though found in the *Araceæ*, *Liliaceæ*, *Melanthaceæ*, and other orders. Aromatic secretions are characteristic chiefly of one order, *Scitamineæ*. Besides palms and grasses, many endogenous plants are of great beauty, and many produce most beautiful flowers. Lilies and orchids are instances.

Endogenous plants are *monocotyledonous* (q.v.); the terms *endogenous* and *monocotyledonous* are therefore often employed indiscriminately to designate the class. But Lindley distinguishes a class of *Dictyogens* (q.v.), which, though monocotyledonous, have stems approaching the exogenous character. The leaves of endogenous plants generally exhibit parallel venation, which is indeed strictly confined to them, though a venation resembling it, or simulating it, may be seen in some exogenous plants. The seed also germinates in a peculiar manner, different from that of exogenous plants, and to which the name *endorhizal* has been given, the radicle being protruded from within the substance of the embryo, and surrounded by a cellular sheath formed from the integument which it breaks in its egress. See ACROGENOUS: EXOGENOUS: COTYLEDON

ENDOLYMPH—ENDORSE.

ENDOLYMPH, n. *ĕn'dō-limf* [Gr. *endon*, within; Eng. *lymph*]: in *anat.*, the limpid fluid of the membranous labyrinth of the ear; the watery humor of the ear, first described by Antonio Scarpa, hence called Liquor Scarpæ, and containing two small calcareous substances called otoconites: see EAR.

ENDOLYMPHAGIAL, a. *ĕn-dō-lim-fāj'ī-al* [Gr. *endon*, within, L. *lympha*, water; *ago*, I conduct]: in *anat.*, pertaining to the internal part of the lymphatic vessels.

ENDOMORPH, n. *ĕn'do-mōrf* [Gr. *endon*, within; *morphē*, form]: mineral inclosed in a crystal of some other mineral. Thus crystals of quartz have been found to inclose endomorphs of pearl-spar, titanite, oxide of iron, epidote, sulphate of barytes, etc.

ENDOMETRIUM, n. *ĕn-dō-mē'trī-ūm* [Gr. *endon*, within; *mētra*, uterus]: the lining membrane of the uterus. **ENDOMETRITIS**, -*trī-tīs*, n. a disease, inflammation of the endometrium.

ENDONEPHRITIS: see PYELITIS.

ENDOPARASITE: see ENTOZOOON.

ENDOPHAGY, n. *ĕn-dōfā-jī* [Gr. *endon*, within; *phagō*, I eat]: that kind of cannibalism in which only persons of the same tribe are eaten. **ENDOPHAGOUS**, a. *ĕn-dōfā-gūs*, practicing endophagy.

ENDOPHLŒUM, n. *ĕn'dō-flē'ūm* [Gr. *endon*, within; *phloios*, the bark of trees]: the inner layer of the bark of trees; the liber.

ENDOPHYLLOUS, a. *ĕn-dōfīl-ūs* or *ĕn'dō-fīllus* [Gr. *endon*, within; *phūlon*, a leaf]: in *bot.*, evolved within a leaf or sheath.

ENDOPHYTE, n. *ĕn'dō-fīt* [Gr. *endon*, within; *phuton*, a plant]: a parasitic plant, usually a fungus, living within another organism.

ENDOPLASM. see CHYME-MASS (CHYME).

ENDOPLEURA, n. *ĕn'dō-plō'rū* [Gr. *endon*, within; *pleura*, a side]: the inner covering of the seed immediately investing the embryo and albumen; the tegmen.

ENDOPODITE, n. *ĕn-dōpōdīt* [Gr. *endon*, within; *podēs*, feet]: in *zool.*, the inner of the two secondary joints into which the typical limb of a crustacean is divided.

ENDOPTILE, n. *ĕn-dōp'til* [Gr. *endon*, within; *ptilon*, a feather]: in *bot.*, having an embryo with the plumule rolled up in the cotyledons, as in the endogenous plants.

ENDORHIZAL, a. *ĕn'dō-rī'zūl* [Gr. *endon*, within; *rhiza*, a root]: having a root within—applied to plants whose rootlets burst first through the coverings of the seed before elongating downward.

ENDORHIZEÆ, n. *ĕn-dō-rīzē-ē* [Gr. *endon*, within; *rhiza*, a root]: in *bot.*, name given in 1808 by Richard to the great sub-kingdom of plants termed by De Candolle, in 1813, *Monocotyledonæ* or *Endogenæ*.

ENDORSE, **ENDORSEMENT**, etc.: see INDORSE, etc.: also BILL.

ENDORSE—ENDOSMOSE.

ENDORSE, *ĕn-dawrs'*, in Heraldry: an ordinary containing the fourth part of a pale. *Endorsed*, or *indorsi*, signifies that objects are placed on the shield back to back.

ENDOSARC, n. *ĕn'do-sârk* [Gr. *endon*, within; *sarkos*, flesh]: in *zool.*, inner molecular layer of sarcode in the Amœba and allied Rhizopods.

ENDOSKELETON, n. *ĕn'dô-skĕl'ĕ-tôn* [Gr. *endon*, with in; *skeleton*, a dry body]: the internal or bony structure of man and other animals, in contradistinction to *exoskeleton*, which is the outer and hardened covering of such animals as the crab and lobster.

ENDOSMOSE, n. *ĕn'dô-smôs'* [Gr. *endon*, within; *osmos*, a thrusting, impulsion]: that property of membranous tissue by which fluids of unequal densities, when placed on opposite sides of it, are enabled to pass through and intermix. ENDOSMOSE AND EXOSMOSE [see EXOSMOSE]: terms applied by Dutrochet, the first investigator, to the transfusion that takes place when two liquids or two gases of different densities are separated by an animal or a vegetable membrane. As the transmission has no necessary relation to outward or inward, the term *osmose*, or *osmotic action*, is now preferred. See DIFFUSION.

This action performs a very important part in living organisms, and explains many phenomena of the circulation of sap and the processes of nutrition, previously referred only to the wonderful action of vital energy. Thus, the blood continually streaming through the capillary vessels, gives forth a portion to the surrounding cells, and so supplies them with the necessary chyle. This may, however, by the expansion of the capillary vessels (see INFLAMMATION), lead to immoderate exudation. On the other hand, the blood, in passing by, takes up a number of worn-out constituents of the juices of these cells, and in this way serves, by the exchange which it effects, to restore the body, and to disburden it of products which have become useless.—In plants also, osmose performs an important part in the process of nutrition and the motion of the sap. The substances in the cells of plants are usually denser than the fluids without, and thus a process of endosmose takes place, by which the plant is supplied in the first instance from the soil, being incapable, however, of appropriating any nourishment which is not presented in a liquid state to the fibrils of its roots; while that which the roots give off by exosmose, is supposed gradually to unfit the soil for the growth of the same kind of plant. The bursting of the capsules of some kinds of plants is owing to a process of endosmose going on in the cells, as in the fruit of the elaterium or squirting cucumber. Some of the *Entozoa*, as tape-worms, seem to live entirely by endosmose. See OSMOSE. ENDOSMIC, a. *ĕn-dôs'mîk*, same as ENDOSMOTIC. ENDOSMOMETER, n. *-dôz-môm'ĕ-ter* [Gr. *metron*, measure]: instrument to measure the rapidity of the passage of a less dense fluid through a membrane which separates it from a denser fluid. ENDOSMOMETRIC, a. *-môm'ĕtrîk*, pertaining to or designed for the measurement of

ENDOSPERM—ENDOWMENT INSURANCE.

endosmotic action. ENDOSMOSMIC, a. -*dōs-mos'īk*, same as ENDOSMOTIC. ENDOSMOT'IC, a. -*mōt'īk*, pertaining to endosmos.

ENDOSPERM, n. ēn'dō-spērn' [Gr. *endon*, within; *sperma*, a seed]: in bot., albumen formed within the embryo-sac. ENDOSPERMIC, a. -*sperm'īk*, in bot., term applied to seeds containing endosperm, as in the *Grammeæ*, *Umbelliferæ*, etc.; relating to or accompanied by the endosperm, as an *endospermic embryo*.

ENDOSPOROUS, a. ēn'dō-spō'rūs [Gr. *endon*, within; *spora*, seed]: applied to fungi that have their spores contained in a case.

ENDOSTOME, n. ēn'dō-stōm' [Gr. *endon*, within; *stoma*, a mouth]: the passage through the inner integument of an ovule.

ENDOTHECIUM, n. ēn'dō-thēshī'ūm [Gr. *endon*, within; *thēkē*, a box]: the inner lining of the anther-cells.

ENDOTHELIUM, n. ēn-dō-thē'lī-ūm [Gr. *endon*, within; *thēlē*, nipple], called also VASALIUM: the lining membrane of serous, synovial, or other closed sacs—somewhat resembling epithelium. ENDOTHELIO'MA, n. -*lī-ō'mā*: malignant tumor, a growth from endothelium.

ENDOW, v. ēn-dow' [en, in; F. *douer*, to give a dowry to; en, in; L. *dotem*; F. *dot*; It. *dote*, a marriage-gift]: to settle on or furnish with in permanency; to settle money or property on permanently; to enrich or provide with, as a gift, quality, or faculty. ENDOW'ING, imp. ENDOWED', pp. -*dowd'*. ENDOW'ER, n. one who. ENDOWMENT, n. that which is bestowed or settled on; property set apart and secured in perpetuity for the support of a church, college, hospital, etc.: any gift of nature, any faculty or quality of mind. ENDOWED SCHOOLS ACTS, in England: see EDUCATION, NATIONAL OR STATE.

ENDOWMENT INSURANCE, SOCIETIES OR ORDERS FOR: see INSURANCE (LIFE INSURANCE).

ENDUE—ENDYMION.

ENDUE, v. *ĕn-dū'* [OF. *endoer* or *endouer*, to endow], to endow; to supply with. ENDU'ING, imp. ENDUED, pp. *ĕn dūd'*. Note.—This is an older spelling of 'endow': *indue*, however, which is a totally different word, is erroneously employed by our best OE. writers in the sense of 'endow': see INDUE.

ENDURE, v. *ĕn-dūr'* [F. *endurer*—from L. *indūrārē*, to make hard—from *in*, in; *dūrūs*, hard: It. *indurare*]: to bear; to suffer with patience; to submit; to undergo; to last; to continue in same state; to remain. ENDU'RING, imp.: ADJ. capable of sustaining. ENDURED', pp. *-dūrd'*. ENDU'RABLE, a. *-rū-bl*, that can be borne. ENDU'RABLY, ad. *-bli*. ENDU'RABLENESS, n. *-bl-nēs*, act or state of that which endures. ENDU'RINGLY, ad. *-li*. ENDU'RER, n. one who. ENDU'RANCE, n. *-rāns*, a bearing or suffering; continuance; patience; fortitude. — SYN. of 'endurance': suffering; resignation;—of 'endure': to abide; continue; brook.

ENDWISE: see under END.

ENDYMION, *ĕn-dīm'i-on*, in Greek Mythology: son either of Zeus or of Aëthlius; he followed, according to some accounts, the occupation of a herdsman or hunter; according to others, was king of Elis. On account of his uprightness, he is said to have received, at his own request, from Zeus, the gift of immortality, unfading youth, and everlasting sleep; but another version is, that Zeus having taken him up to Olympus, E. fell in love with Here (Juno), and was condemned by her enraged husband to eternal sleep on Mount Latmos. Others, again, prettily fable that Selene (the Moon), charmed by the beauty of the youth, conveyed him to Caria, and sent him to sleep on Mount Latmos, that she might nightly kiss him unobserved. The Eleans, on the contrary, declared that he died among them, and in proof of it were wont to show his monument. The myth of E. has been happily interpreted by Max Müller in his article on Comparative Mythology, in *Oxford Essays* (1856). E., according to him, is one of the many names of the sun, but with special reference to the setting or dying sun, being formed from *enduo*, probably a dialectic variety of *duo*, a Greek verb which means 'to go down' as the sun. E. sleeps in the cave of Latmos, i.e., of night (from the same root as Leto or Latona, the night). So far the myth poetically describes certain phenomena of nature, the sinking of the sun in the west, and the rising of the moon, that seems to follow his departing beams. But the original signification of the metaphors becoming lost, as might naturally happen when the words expressing them had only a local usage, it was, we may say, inevitable that people should transfer the metaphors to persons, and invent a history to supply the place of the vanished poetry. And this invention, or, more properly, explanation (for it was doubtless made in good faith), is what properly constitutes the myth of Endymion. The story has been made the subject of a poem by Keats.

ENDYMION, n. *ĕn-dīm'i-on*: in bot., genus of *Liliaceæ*,

ENE—ENEMY.

tribe *Hemerocallideæ*. *Endymion nutans* is one of the names given to the English bluebell; the *Hyacinthus non-scriptus* and the *Agraphis nutans* of other botanists.

-ENE in *chem.*, verbal termination to denote that the fatty hydrocarbon belongs to the olefine series, C_nH_{2n}. But this termination is applied to hydrocarbons of the aromatic series without regard to their formula; thus, naphthalene, C₁₀H₈, ought to be called naphthaline.

ENEZIA, n. ē-nē'shī-a [Gr. ἔνεκτις, lasting, continuing]: in *med.*, continued fever, including inflammatory typhus, and synochal fevers.

ENEID, or ÆNEID, n. ē'nē-īd: a famous Latin epic poem by the anc. poet Virgil—so named from its chief hero, Æneas, ē-nē'ās: see ÆNEAS.

ENEMA, n. ē-nē'mā [Gr. ἐνέμη, I cast or throw in]: a medicine conveyed into the body by injection through the rectum into the lower bowel: see CLYSTER.

EN'EMIES, OF THE UNITED STATES: any kind of assistants, whether by joining in acts of hostility, or sending supplies, etc., to subjects of states at war with this country—such subjects being held as enemies, even though war may not have been solemnly proclaimed: see ENEMY. All such aid and comfort is by the constitution, treason. To incite to hostilities, the subjects of a state at amity with the United States does not fall under this provision. But if the subjects of a friendly state make a hostile invasion, any U. S. citizen rendering assistance is deemed guilty of treason. See TREASON.

ENEMY, n. en'e-mī [F. ennemi—from L. inimicus, an enemy—from in, not; amicus, a friend: It. inimico]: one who hates another person: a foe; an adversary; an opposing armed force, naval or military; opponent; antagonist.—*Enemy*, in *civil law*, is one with whom war has been publicly declared; all other kinds of assailants are pirates or robbers. *Hostes hi sunt qui nobis, aut quibus nos, publice bellum decrevimus; ceteri latrones aut praedones sunt.*—*Digest*, i. 16, 118. Thus, in order to constitute an enemy, there must be a public declaration of war. This declaration must also be made by a duly organized state or kingdom, for a declaration of war by any turbulent body of men is not sufficient; and a hostile act committed by private citizens will not justify a war, unless that act be sanctioned or wantonly permitted by the government. The purpose for which this public declaration is required, is stated by Grotius to be that it may be clearly known that the war is undertaken not as a venture, but by the will of the two people. Hostilities having been formally declared, every subject of the hostile nations becomes an enemy of the opposing state, as do likewise those independent nations which attach themselves to the interests of either party. According to ancient usage, the utmost violence and cruelty was lawful toward those who were enemies of the state; but by the humane principles which prevail in modern times, warfare is to be carried on subject to certain gen-

ENEMY.

eral rules, which are intended as much as may be to abridge the calamities of war, and to protect the rights of individuals. Thus, an army invading an enemy's country is bound to allow, as far as possible, the peaceable inhabitants to remain unmolested. Unnecessary devastation of the country and the seizure of private property are also contrary to the laws of civilized war; and Grotius lays it down that the use of poisoned weapons, and of assassination, and violence to women, are to be reprobated. On the other hand, individuals taking up arms, without the sanction of the state, in order to annoy an invading enemy, are regarded as lawless marauders. The result of this distinction is, that such persons are treated not as prisoners of war, but are subject to be summarily dealt with by the commander of the invading army. As to the right of individuals to fit out vessels for the annoyance of the enemy, see PRIVATEER: PIRACY. It appears to be a recognized principle of international law, that the property of an alien enemy residing in either of the hostile states may be confiscated. The Americans, during the war with England, asserted this right in regard to British property found in their territory. But the usage of civilized nations for a long period has much modified the stern rule of law. It is provided by Magna Charta, cap. 30, that if merchants 'be of a land making war with us, and be found in our realm at the beginning of the wars, they shall be attached without any harm of body or goods, until it be known to us, or our chief justice, how our merchants be intreated there in the land making war against us: and if our merchants be well intreated there, theirs shall be likewise with us.' And by 27 Edw. III. c. 17, merchants of a foreign state at war with Britain were allowed 40 days, after proclamation of hostilities, wherein to remove from the kingdom themselves and their goods; and if that space of time were not sufficient, 40 days more were to be conceded to them. Vattel (iii. 4, 63) denies that the right to confiscate the goods of an alien enemy is a right inherent in a state by the law of nations, insisting that a sovereign having permitted foreigners to enter the state, and to continue there, had tacitly promised them full liberty and security for their return. Whatever be the principle, there is no doubt that the universal practice of modern nations has been to respect the property of individuals at the outbreak of hostilities. Provisions are frequently inserted into commercial treaties, stipulating that, in case of war, the subjects of the enemy shall have time to depart, and even that they should be allowed to remain and carry on peaceable trade. As to the practice in regard to EMBARGO and LETTERS OF MARQUE, see those titles. The right to confiscate the debts of the subjects of a hostile nation appears to rest on the same basis as that of the confiscation of other property. Trade between the subjects of two hostile powers is absolutely suspended during hostilities, unless permitted by express sanction; and the importation of articles, particularly useful in war is contraband. All such articles, whether supplied by subjects of the enemy, or of another

ENERGETICS—ENFANTIN.

state, are seized and confiscated: see CONTRABAND OF WAR: also PRIZE: PRISONERS OF WAR: INTERNATIONAL LAW: GENEVA CONVENTION. (Grotius, *De Jure Belli et Pacis*, lib. iii. cc. 3 to 7; Kent's *Commentaries*, I. c. 3.)

ENERGETICS, n. *ěn-ěr-jět'iks*: in *nat. philos.*, branch of science which investigates the laws relating to physical or mechanical forces, as distinguished from vital. It thus comprehends the consideration of the whole range of physical phenomena.

ENERGICO, *ěn-ěr'jē-kō*: Italian term in music, meaning with energy and force; with strong articulation and accentuation, and a marked powerful delivery of the single notes, without losing in distinctness of execution.

ENERGUMEN, n. *ěn-ěr-gū'měn* [Gr. *energoumenos*, possessed with an evil spirit; *energeō*, I am in action]: in *theol.*, one possessed by a spirit, specially by an evil one; a demoniac.

ENERGY, n. *ěn'ěr-ji* [F. *énergie*—from Gr. *enérgeiā*, action, energy—from *en*, in: *ergon*, work]: power; force; power of doing work (q.v.); vigorous action; efficacy; spirit; life. ENERGETIC, a. *-jět'ik*; or ENERGETICAL, a. *-i-kāl* [Gr. *energētikós*, having the power of acting, energetic]: possessing force or vigor; vigorous; forcible; powerful; effective. ENERGETICALLY, ad. *-lī*. ENERGIZE, v. *ěn'-ěr-jiz*, to operate with vigor; to give energy or strength to. ENERGIZING, imp. ENERGIZED, pp. *-jizd*. DISSIPATION OF ENERGY, the tendency of all energy in the universe to pass into a comparatively useless and unmanageable form, such as uniformly diffused heat: see DYNAMICS: FORCE: THERMO-DYNAMICS.—SYN. of 'energetic': strenuous; potent; efficacious;—of 'energy': vigor; strength; efficiency; emphasis; activity.—CONSERVATION OF ENERGY: see FORCE.

ENERVATE, v. *ěn'ěr-vāt* or *ě-něr'vāt* [L. *enervātus*, enervated, rendered effeminate—from *e*, out; *nervus*, nerve: It. *enervare*: F. *énerver*¹: to render feeble; to weaken; to enfeeble; to deprive of strength; to debilitate; to unnerve: ADJ. weak; without strength or force. ENERVATING, imp.: ADJ. weakening; enfeebling. ENERVATED, pp. enfeebled. ENERVATION, n. *ěn'ěr-vā'shūn* [F.—L.]: the act of weakening; a weak state of body or debility arising from nervous disorders. ENERVIS, a. *ě-něr'vīs* [L.]: in *bot.*, without nerves or veins. ENERVE, v. *ě-něr've*, in *OE.*, to break the force of; to weaken. ENERVING, imp. ENERVED, pp. *ě-něrv'd*.

EN FAMILLE, *āng fā-mēl* [F.]: in a family or private manner; domestically.

ENFANTIN, *ǒng-fǒng-tǎng'*, BARTHÉLEMY PROSPER: the chief representative of St. Simonism, and as such, usually styled *Père Enfantin*: 1796–1864, Aug. 31; b. Paris; son of a banker. He became a pupil in the *École Polytechnique* 1812, but was expelled 1814, for having joined the pupils who left school and fought against the allies on the heights of Montmartre and St. Chaumont. He was afterward a commercial traveller in Russia, then a banker's clerk, and in 1825 became director of the *Caisse Hypothécaire*.

ENFEEBLE—ENFIELD.

About this time he became a disciple of St. Simon, whose ideas he developed, after the death of their author, in the *Producteur*. After the July revolution, E. associated himself with M. Bazard for the active propagation of St. Simonism. Bazard preached it in its relations to philosophy and politics; E. in its relations mainly to the social state. Soon, however, a schism broke out between the two on the question of marriage and the relation of the sexes. Recognizing the ‘mobility’ of the affections, E. affirmed that they ought to be ‘free,’ and of course pronounced against the ties of marriage. E.’s views were pushed so far that government deemed it necessary to interfere on the grounds of public decency. The ‘Supreme Father’ (as his disciples were wont profanely to call him) was, after a trial of two days, sentenced to two years’ imprisonment, and to pay a fine of 100 francs. Being released at the expiration of a few months, E. went to Egypt, and, after an absence of two years, returned to France, and became a post-master and farmer in the vicinity of Lyon. In 1841, he came to Paris, and was appointed a member of the Scientific Commission for Algiers, and on his return from Africa, wrote a sensible, interesting book, entitled *Colonisation de l’Algérie* (Paris 1843). After the revolution of 1848, he edited the journal entitled *Le Crédit Public*, a paper retaining much of the old St. Simonian character, but which had to stop in 1850 for want of funds. E. afterward held an important situation on the Lyon and Mediterranean railway. His principal works are his *Doctrine de St. Simon*, in conjunction with others (1830); his *Traité d’Économie Politique*; *La Religion Saint-Simonienne* (1831); *Moral*; *Le Livre Nouveau* (1832); *Correspondance Philosophique et Religieuse* (1847); *Correspondance Politique* (1849); *La Vie Éternelle, Passé, Présent, Future* (1861).

ENFEEBLE, v. *ĕn-fĕ'bl* [*en*, and *feeble*]: to weaken; to reduce the strength of. **ENFEEBLING**, imp.: ADJ. weakening; debilitating. **ENFEEBLED**, pp. *-bld*: ADJ. weakened; deprived of strength. **ENFEEBLEMENT**, n. *-bl-mĕnt*, the act of weakening.

ENFELON, v. *ĕn-fĕl'ōn* [*en*, and *felon*]: in *OE.*, to have the character of a felon; to inude with fierceness. **ENFELONING**, imp. **ENFELONED**, pp. *-fĕl'ōnd*, filled with fierceness or cruelty.

ENFEOFF, v. *ĕn-fĕf'* [*en*, in, and law L. *feūfārē*, to confer a fee on one (see **FEE** and **FEUDAL**)]: to invest with a fee or estate; to give a right of property in lands or houses by a deed or instrument. **ENFEOFFING**, imp. **ENFEOFFED'**, pp. *-fĕft'*. **ENFEOFF'MENT**, n. the act of giving the fee-simple of an estate; the deed or instrument by which it is given: see **FEOFF**.

ENFETTER, v. *ĕn-fĕt'ter* [*en*, and *fetter*]: in *OE.*, to hold or bind in fetters.

ENFIELD, *ĕn'fĕld*: town of Hartford co., Conn.; on the Conn. river, and the New York New Haven and Hartford railroad; 16 m. n. of Hartford. It contains the villages of Thompsonville, noted for its great carpet factory with over

ENFIELD—ENFRANCHISE.

300 looms and a manufacturing capacity of nearly 6,000,000 yds. annually; and Hazardville, where is one of the most extensive powder mills in the world, beside a community of thrifty Shakers. The first bridge over the Conn. river was built from E. to Suffield 1808; an iron truss bridge was erected below it 1866 at a cost of \$265,000; and a canal $5\frac{1}{2}$ m. long has been constructed around the falls of the Conn. within the town limits. E. has several churches, high school, savings bank, and sewing-machine, plow, carriage, sash and blind, hat, brick, and harness factories. It was settled 1681, and belonged to Springfield, Mass., till 1752. Pop. (1880) 6,755; (1900) 6,699.

ENFIELD, *ĕn'fĕld*: village of Middlesex co., England. It has a government manufactory of small arms capable of producing 5,000 rifles a week; the weekly output, however, except in emergencies, does not exceed 1,800. Pop. (1881) 19,104; (1891) 31,532.

ENFIERCE, v. *ĕn-fĕrs'* [*en*, and *fierce*]: in *OE.*, to make fierce. **ENFIERCED**, pp. *ĕn-fĕrst'*, made fierce.

ENFILADE, v. *ĕn'fi-lăd'* [F. *enfilade*, a range, a row—from *en*, in; L. *filum*, F. *fil*, a thread: It. *infilare*: Sp. *enfilar*]: to scour, rake, or pierce with shot or shell a body of soldiers in the direction of the length of the line which they form; to sweep the deck of a ship, or a treuch, or line of rampart, from end to end, with shot or shell: N. a line or straight passage; the situation of a place which may be raked with shot in the direction of its length; the fire of artillery raking a trench or a line of soldiers. **EN'FILADING**, imp. **EN'FILADED**, pp.—A besieging battery so placed as to send its shot along any part of the line of a fortification, and inside the parapet, does great execution in dismounting the guns, which thus present the largest surface to the balls. Hence the rampart lines should be so planned that their prolongations may fall in situations inaccessible to the enemy. Where this is not possible, the lines are either broken, or are protected by bounets (q.v.), or by traverses (q.v.), or blindages (q.v.). In the siege of a fortress, the trenches of approach are cut in a zigzag, to prevent the defenders enfilading them from the walls.

ENFORCE, v. *ĕn-fōrs'* [F. *enforcir*; OF. *enforcer*, to strengthen: *en*, to make, and *force*]: to constrain; to compel; to urge with energy; to give strength or force to; to put in execution, as the law; to impress on the mind; to drive. **ENFOR'CING**, imp. **ENFORCED'**, pp. *-fōrst'*. **ENFORCE'MENT**, n. compulsion; a putting into execution. **ENFOR'CEDLY**, ad. *-lī*.

ENFORME, v. *ĕn-fawrm'* [*en*, and *form*]: in *OE.*, to direct; to fashion.

ENFOULDERED, a. *ĕn-fowl'dĕrd* [*en*; OF. *fouldre* or *foldre*—from L. *fulgur*, a flash of lightning]: in *OE.*, mixed with lightning.

ENFRANCHISE, v. *ĕn-frān'chiz* [*en*, in or on, and *franchise*]: originally, to set free, as from slavery, restraint, or disability; to invest with civil and political privileges; to

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admit to all the rights and privileges of a freeman; to invest with the right of voting for public officials. ENFRAN'-CHISING, imp. ENFRAN'CHISED, pp. -chizd. ENFRAN'-CHISEMENT, n. the admission to civil and political rights and privileges. ENFRANCHISEMENT OF COPYHOLDS: see COPYHOLD.

ENGADINE, *ĕn-gā-dēn'*: famous valley in Switzerland, canton of Grisons, second only to the Valais in length, extending n.e., about 65 m. along the banks of the Inn, from the foot of Mount Maloja to the village of Martinsbruck. It is divided into two portions—that toward the s.w., called the Upper E., and that toward the n.e., the Lower E. The latter is wild and bleak; pent up within narrow limits among the hills, and having a huge barrier of glaciers between it and Italy, its climate is dismal. Frost and snow occur in July, and winter prevails for nine months of the year. The Upper E. is more open, and has much fine meadow-land. The Inn, which enters the valley at its s.w. or upper extremity, and flows through it, has many towns upon its banks, the highest of which, St. Moritz, is about 6,000 ft. above sea-level, while the lowest, Martinsbruck, is 3,343 ft. The inhabitants apply themselves principally to the rearing of cattle; they also make cheese, and export it largely. More than one-half of the young men emigrate at an early age, and betake themselves to continental capitals, where they often attain comparative wealth, in which case they almost invariably return, build a house in their native valley, and therein spend the remainder of their days. Nearly all the people are of the Reformed or Calvinistic Church. The language generally spoken is the Ladin (a corruption of Latin), a Romanic tongue, but differing from the other Romanic dialects of the Rhaetian Alps, and resembling the Italian. Pop. abt. 11,000.

ENGAGE, v. *ĕn-gāj'* [F. *engager*, to enlist—from *en*, in; *gage*, a pledge]: to occupy, as one's time; to undertake; to win, as affection; to hold, as the attention; to embark in, as in business; to bespeak, as rooms or a partner in a dance; to bind one's self as surety; to enlist for a service; to unite by contract; to begin to fight. ENGA'GING, imp.: ADJ. *wiñning*; attractive; pleasing. ENGAGED', pp. -gāj'd': ADJ. pledged; promised; affianced; attached; earnestly employed. ENGA'GEDLY, ad. -jēd-lī. ENGA'GEDNESS. n. -jēd-nēs. ENGAGE'MENT, n. [F.—L.]: a mutual agreement to fulfil an arrangement or contract at a specified time; an appointment; a fight; a battle; an obligation; a compact. ENGAGEMENT OF MARRIAGE: see BETROTHMENT. MILITARY ENGAGEMENT, conflict between two armies or hostile forces. Almost every term applicable to armies in the field bears relation, in some way or other, to a hostile engagement: see those titles. NAVAL ENGAGEMENT, conflict in which vessels of war are engaged. In the small war-vessels of ancient times, before the invention of gunpowder, a naval engagement usually began by running the galleys violently against each other, to crush or sink the enemy by means of the beak or prow. The prows were, for this purpose,

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armed with brazen or iron points. On the deck was sometimes a kind of turret filled with soldiers, the probable precursor of the *forecastle* in modern ships; and there was also frequently a platform for accommodating swordsmen, slingers, and javelinmen. High and bulky ships, of no great length, were best for this kind of warfare. Sometimes a massive piece of iron or lead, called a *dolphin*, was let down violently from the yard arm, to crush or break through some part of the enemy's vessel. The men fastened sickles to the end of long poles, to cut the enemy's rigging and sails. Other means for carrying on a hostile attack were *battering rams*, heavy maces with very long handles, stone-throwing machines, and grappling irons.

In modern ships, preparations for an engagement are made with utmost coolness and precision. The boatswain and his mates communicate to all the crew the order to 'clear for action.' The men take their hammocks, lower them, tie them up, and carry them to the quarter-deck, poop, forecastle, and other parts of the ship, where they are stowed between a double netting above the gunwale, and form a partial defense against the enemy's musketry. The sails, yards, booms, bowsprit, etc., are secured by strong chains and extra ropes, to prevent or lessen disaster if they are shot away. The boatswain and the carpenter collect and place at hand all kinds of pieces of wood, iron, ropes and canvas that they may be useful in quickly repairing shot-holes and other damage. The gunner and his mates examine the cannon and the filled cartridges, and see that all the implements for gunnery are at hand. The master and his subordinate officers look to the trim and state of the sails. The lieutenants visit all the decks, to see that obstructions of every kind are removed. When the engagement is about to begin, the drums beat to arms. Every man repairs to his place. The marines are drawn up in rank and file on the quarter-deck, poop, and forecastle. The surgeon and his assistants are ready in the cockpit to amputate limbs, extract bullets, and dress wounds. Then begins the battle, which varies in its character according to the number and kind of ships on each side, the nature of the sea, the direction of the wind, and a multitude of other circumstances. When the battle is ended, if it has been severe, the probabilities are that many men have been killed or wounded, decks and sides battered and splintered, cannon dismounted, rigging, masts, yards, and sails destroyed or torn. The whole ship's crew, except those disabled, then work diligently on repairs.
SYN. of 'engagement': employment; occupation; avocation; business; promise; word; combat; contest.

ENG AND CHANG: see SIAMESE TWINS.

ENGARRISON, v. *ēn-gār'i-sūn* [*en*, in, and *garrison*]: to protect by a garrison; to furnish with a garrison.

EN-GEDI, *ēng'ghē-dī* (Arabic, *Ain-Jedi*, 'fountain of the kid'): strictly, the name of a perennial fountain on the w. side of the Dead Sea, but is applied also to the wilderness back of the fountain, and to the difficult pass leading

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up to it. Here in the days of Abraham (B.C. 1900) the Amorites dwelt securely in the caverns of the rocks until they were driven out by allied forces of northern kings. More than eight centuries later (B.C. 850) David, in his flight from Saul, took refuge in the same caverns ‘among the rocks of the wild goats.’ After David, Solomon, not needing the caverns for defense, used the fountain in irrigating the surrounding region, and thus made famous vineyards and gardens; of which the terraced ruins yet remain. A thousand years later (in the time of Christ) the Jewish sect of the Essenes, fleeing not from hostile armies but, as they supposed, from the corrupting influences of social life, made their homes in the silent caverns around the flowing waters. And, 18 centuries after Christ, Drs. Robinson and Smith, travellers from the western world, on a tour to the Dead Sea, descending a frightful pass more difficult than those of Lebanon or of the Alps, came suddenly to the beautiful fountain bursting forth in a copious stream from a ledge of the rock and rushing down, between a thicket of shrubs and trees, 400 ft. into the sea. And the cliffs were still a refuge for the wild goats as they had been thousands of years before.

ENGELHARDT, ēng'ēl-hārt, JOHANN GEORG VEIT: 1791, Nov. 12.—1853, Sep. 13; b. Neustadt on the Aisch: German theologian. He studied at Erlangen, where, 1820, he was appointed extraordinary prof., and in 1822 ordinary prof. of theology. Patristic and mediæval dogmatics, and Neoplatonism, are the chief subjects which he investigated. In 1820, he published at Erlangen, a translation of the first *Ennead* of Plotinus; in 1823 appeared his translation of the writings ascribed to Dionysius the Areopagite. His *Kirchengeschichtlichen Abhandlungen* (Erl. 1832), *Auslegung des Speculativen Theils des Evangeliums Johannis durch einen deutschen mystischen Theologen* (Erl. 1839), and his contribution to the history of the mystical theology, entitled *Richard von St. Victor und Johannes Ruysbroek* (Erl. 1808), are works of great value, and have thrown a new light on many important points. Very useful, too, especially for the richness of their special notices, are his *Handbuch der Kirchengeschichte* (Erl. 1834), and *Dogmengeschichte* (Neustadt 1839). E. wrote many learned dissertations in the *Journal of Historical Theology*, among which were *Ueber die Hesychiasten*, and *Ueber Erasmus Sarcerius*.

ENGELHARDTIA, n. ēn-jēl-hārd'shi-a [named after a Dutch gov. of the n.w. part of Java]: in bot., genus of *Juglandaceæ*. It consists of very resinous trees. *Engelhardtia spicata* is a large tree, 200 ft. high, the trunk of which, in Java, is cross-cut into cart-wheels.

ENGENDER, v. ēn-jēn'dér [F. *engendrer*, to generate; to produce—from L. *ingēnērārē*, to engender—from *in*, in; *genērō*, I breed, I bring forth: It. *ingenerare*]: to form; to cause to exist; to occasion; to produce. ENGEN'DERING, imp. ENGEN'DERED, pp. -dér'd.—SYN. of ‘engender’: to breed; procreate; propagate; generate; beget; cause; form.

ENGHien—ENGINE.

ENGHien, *ĕng-ghe-ăng'*, LOUIS ANTOINE HENRI DE BOURBON, Duc d': 1772, Aug. 2.—1804, Mar. 20; b. Chantilly, France; only son of Prince Henri Louis Joseph, Duc de Bourbon. In 1789 he travelled through several countries of Europe. In 1792 he entered the corps of *émigrés* assembled by his grandfather, the Prince of Condé, on the Rhine, and commanded the vanguard 1796–99. At the peace of Lunéville, 1801, he went to reside at Ettenheim, an old château on the German side of the Rhine, not far from Strasburg, and within the territories of the Duke of Baden. Here he married the Princess Charlotte of Rohan Rochefort, and lived as a private citizen. When the conspiracy of the Bourbon princes, headed by Cadoudal, Pichegru, etc., against the life and authority of Bonaparte, was discovered at Paris, the latter chose to believe that the Duc d'E. was privy to it, although there was not a tittle of evidence to prove this. Perhaps Bonaparte was afraid that the valor and humanity of the last descendant of the great Condé might at some day prove dangerous to his power. Be that as it may, he unscrupulously resolved to seize the person of the duke. On the night of 1804, Mar. 17, the neutral territory of Baden was violated, and the château of Ettenheim surrounded with a body of soldiers and gendarmes. The duke, at first, endeavored to defend himself; but the force was too great to be opposed, and he, with several friends and domestics, was captured, and carried prisoner to Strasburg, and immediately afterward to Vincennes. On Mar. 20 he was tried before a court martial of eight officers, and after an examination of five hours was condemned to death. Half an hour later the sentence was put into execution. So cruel and audaciously criminal an act has fixed a deep and lasting stigma on the character of Bonaparte. M. Dupin has published the records of the trial, and shown the illegality of the proceedings of the military commission. This illegality was publicly acknowledged by General Hullin, president of the court. After the Restoration, the bones of the judicially murdered duke were taken up, and interred in the chapel of the castle at Vincennes.

ENGINE, n. *ĕn'jĕn* [F. *engin*, an engine, a tool—from L. *ingēniūm*, innate or natural quality: It. *ingegno*]: any mechanical contrivance; a machine composed of many or different parts in order to produce a certain result; any combination of the mechanical powers for producing an effect. ENGINEMAN, n. one who has charge of or attends to an engine. ENGINEER', n. *-jĕ-nĕr*, one who constructs or manages an engine; one who is skilled in forming plans of work for offense or defense for an army; a designer of great machines to be employed in the arts and manufactures; one employed in planning and superintending the formation of public works, such as roads, etc. ENGINEERING, n. the work, skill, business, or profession of an engineer; the practice of an engineer. ENGINERY, n. *ĕn'jĕn-rī*, in *O.E.*, engines of war; artillery. CIVIL ENGINEERING, art of designing and superintending works of a constructive character, such as roads, railways, bridges,

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canals, harbors, docks, works for supplying water to towns, drainage and sewerage works, mining machinery, and the working of metals.

The civil engineering profession is subdivided into several sections. The railway engineer projects and superintends the execution of railways and all the works in connection with them, such as the alteration of roads and streams, the construction of viaducts, bridges, cuttings, and embankments. The hydraulic engineer constructs the works connected with the supply of water to towns, the filtering of water, its collection in reservoirs, and its distribution through a town or district; the irrigation and drainage of tracts of country; the protection of low lands from inundation, and the use of water as a motive power. The dock and harbor engineer has the management of all works connected with the sea or navigable waters, such as the construction of piers, breakwaters, docks, harbors, and light-houses. The mechanical engineer is concerned principally in the manufacture of machinery, the working of metals, the construction of ships, steamers, cannon, and all the various structures in which the metals bear a prominent part. The mining engineer discovers minerals and manages mines; there are engineers also engaged specially in the drainage of towns; and there are other less prominent divisions of the profession.

In all engineering works, the *contractor* takes a very important part; he executes the works from the designs, and under the direction and superintendence of the engineer, and on his ability and good management the success of undertakings materially depends.

The engineering works of antiquity are numerous and prominent, many of them remaining while all other traces of their construction have been swept away. The most notable of the works belonging to very remote antiquity are the harbors of the Phœnicians, the palaces and sewerage of Nimroud, and the pyramids of Egypt; next in order come the harbors of ancient Greece, the bridge of boats across the Dardanelles, made by Xerxes, to transport his immense army into Europe, and his canal across the isthmus of the peninsula of Mount Athos. The constructions of ancient Rome claim attention—its theatres, temples, baths, and aqueducts, some of which carried water from distances of more than 50 m. into Rome; its roads, bridges, and drainage-works vie in extent and magnificence with the most celebrated works of modern times.

From that period down to the commencement of the 18th c., the most extensive works executed are the canals, embankments, and other hydraulic constructions by the Dutch for purposes of inland navigation, and to protect their low lands from the sea; the canals of n. Italy, the cathedrals and fortifications of mediæval Europe.

Civil engineering, as a distinct *profession* may be said to have originated, in England, about the middle of the last century; since that time, the improvements in the steam-engine by James Watt, its subsequent application to the railway system by George Stephenson, and its use in navi-

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gation, have given a great impulse to commerce and civilization; which, in their turn, have created in many countries the necessity for the numerous and magnificent engineering works of modern times; such as innumerable railways, roads, and canals; and the bridges, water-works, docks, harbors, and vessels that facilitate commerce.

The education of those who would rise to eminence in the profession, must embrace a fair knowledge of pure mathematics and of the mixed sciences of natural philosophy, such as mechanics, hydrostatics, hydraulics, and optics. They should acquire a knowledge of the principles of projections, and should aim at being good draughtsmen and rapid and accurate arithmeticians.

Engineering is represented in and furthered in the United States and Britain by active and prosperous institutions and societies of engineers, mostly modelled after the London Institution of Civil Engineers, established 1818. The profession, gathering bright and active minds, and demanding science and perseverance, is in high public esteem, and will doubtless increase in importance.

For the more important operations involved in engineering, see BRIDGE: CANAL: AQUEDUCT: DIKE: EMBANKMENT: TUBULAR BRIDGE: ROADS AND ROAD-MAKING: RAILWAYS: RIVER: SUSPENSION BRIDGE: TUNNEL: ETC.

MILITARY ENGINEERING, art of designing and constructing fortifications and other military works. The military engineer is an officer in the service of government, whose duties, besides the construction of fortifications, are to make surveys for warlike purposes, and to facilitate the passage of an army by the construction of roads and bridges. He is also often called upon to undertake or supervise many works which more properly belong to the business of the civil engineer, such as the survey of the country and the inspection of great public works.

ELECTRICAL ENGINEERING is a branch of mechanical engineering that has developed into a separate profession of great importance since the rapid increase in the use of electricity in the last 20 years; it deals with all the problems connected with the development, transmission, and transformation of electrical energies into light, heat, and power.

ENGINEERS' IN THE UNITED STATES NAVY: commissioned non-combatant officers, of the grades of 1st and 2d asst. E., passed asst. E., and chief E., having charge of the machinery of steam vessels. Besides being familiar with the management, construction, and erection of nautical steam machinery, they must be skilled mechanics, competent to make and superintend all necessary repairs to engines, boilers, and machinery for operating batteries, in navy-yards, at sea, and in action, and also possess a knowledge of the various properties and powers of steam.

ENGINEERS', UNITED STATES CORPS OF: branch of the military service created by act of congress 1802, Mar. 16, and originally constituting the U. S. Milit. Acad. The act provided that the corps should consist of 1 col., 1 lieut.-col., 2 majors, 4 captains, 4 first lieutenants, 4 second lieutenants, and sufficient cadets to bring the whole num-

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ber to 20; that it should be stationed at West Point, N. Y.; and that its entire force should be under the direction of the pres. of the United States. In 1806, Apr., it was provided that the engineers were not to assume, nor be ordered on, any duty beyond their special profession, except by direction of the pres. (63d Art. of War); in 1838, July, the corps was increased from 20 to 47, and a subordinate branch, designated the corps of topographical engineers, was organized; in 1846, May, a company of sappers, miners, and pontoniers was authorized to be formed and attached to the corps; and in 1861 the corps was enlarged by congress and styled the battalion of engineers. The separate corps of topographical engineers was abolished 1863 and its officers merged with the corps of engineers. On the reorganization of the army, 1866, the corps was made to consist of 1 chief of engineers, with the rank and pay of a brig. gen., 6 colonels, 12 lieut. colonels, 24 majors, 30 captains, and 26 first and 10 second lieutenants. In 1895 there were also 11 additional second lieutenants, and a battalion of engineers, with a lieut. colonel, 4 captains, a first and 3 second lieutenants, and 10 additional second lieutenants. As the corps originally constituted the Milit. Acad., all the superintendents of that institution were appointed from the corps till the act of 1866, July 13, which threw the office of supt. open to all arms of the service. The corps has special charge of the construction and repair of sea-coast defenses and of the improvements of harbors and rivers authorized by congress. See TOPOGRAPHY, MILITARY.

ENGIRD, v. *ĕn gĕrd'* [*en*, and *gird*]: to encircle; to surround. ENGIRD'ING, imp. ENGIRD'ED, or ENGIRT', pp. *-gĕrt'*.

ENGISCOPE, n. *ĕn'jĭ-skōp* [Gr. *engus*, near; *skopeo*, I view, I see]: reflecting microscope, invented by Amici, in which the image is viewed at a side aperture in the tube, in a manner similar to the Newtonian telescope.

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ENGLAND, *ing'land*: southern and larger section of the island of Great Britain, and the most important member of the United Kingdom of Great Britain and Ireland. For the geography of E. see GREAT BRITAIN. This article sketches its history previous to the union with Scotland.

Of the inhabitants of E. before the Christian era, little is known. In some of the ancient geographers, there are a few scattered notices of a rude population, with whom a limited commerce in tin was carried on by the Phœnician merchants; and our information scarcely extends further. For what is known of E. under the Roman occupation, see BRITANNIA. For an account of the country during the period between the withdrawal of the Romans and the Norman Conquest, see ANGLO-SAXONS.

When William of Normandy landed in E. to claim the crown which Edward the Confessor had bequeathed to him, he found that the people had raised to the throne Harold, the son of a popular nobleman. The resources of the Saxons, however, had been wasted in domestic conflicts before the attack of William; and the battle of Hastings (1066) gave E. with comparative ease to the Normans. The next 20 years saw the conquest completed, and nearly all the large landed estates of the Saxons pass, on every pretext except the true one, into the hands of the Normans. William claimed, indeed, to rule as sovereign by hereditary right, but this made little difference to the fact of conquest. All the high offices in the state and in the church passed into the hands of a new race. The Danes alone could retain either property or dignity. For long, some of the Saxons maintained an unequal resistance, retiring to the forests as the outlaws whose adventures furnished the materials for those favorite popular legends, where, as in Robin Hood, the spoiling of the richer classes is depicted as one of the chief virtues. In the course of time, the Normans were absorbed among the Saxons, their very language disappearing, though leaving many traces. From this union arose the English people and the English language as they now exist.

The union of the Normans with the Saxons was not fully effected so long as the Normans retained their foreign possessions. In King John's reign, the whole of these were lost, excepting Guienne and Poitou. Long wars under Henry III. and Edward III., and his famous son, the Black Prince, were continued, in the endeavor to regain the lost possessions; yet great victories like those of Cressy (1346) and Poitiers (1356) seemed to leave no result, for no sooner were the English armies withdrawn, than the populations returned to their French allegiance. After Agincourt (1415), Henry V., when by force he had caused himself to be acknowledged heir to the French throne, was virtually king of France, and held his court in Paris; yet, in a few years more the tide turned, the rebellion of Joan of Arc came, and (1451) nothing of foreign ground was left the Eng. king excepting Calais. England was soon further weakened by the Wars of the Roses (1450-85).

To their efforts to conquer France, the Norman kings

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added others. Henry II. conquered Ireland (1171), Edward I. conquered Wales (1285), and had almost added Scotland to his dominions. The bravery of Wallace and Bruce defeated the armies of Edward II., his successor; and though the idea of the conquest of Scotland was always a favorite one, an opportunity for attempting it on a great scale never again presented itself.

The great struggles of the successors of William were with the ecclesiastics and with the barons. Sometimes in these the popular sympathies were with, sometimes against the crown. The conqueror himself and his immediate successors had no difficulty in maintaining the superiority of the courts of justice over the ecclesiastics; but even a sovereign so bold and skilful as Henry II. was forced, after the outcry occasioned by the murder of Thomas-à-Becket (1170), to yield the point. The right to nominate the higher ecclesiastics also was secured by the popes. The degradation of the English monarchy was at its lowest when King John consented (1215) to hold the crown as a gift from Rome. The weaknesses of this monarch had good as well as evil results: from him the barons won their Great Charter (1215). From Henry II. something similar had already been gained; but it was the Magna Charter of John which established two great English principles—that no man should suffer arbitrary imprisonment, and that no tax should be imposed without the consent of the council of the nation. Under Edward I., the famous statute that no manner of tax should be imposed without the common consent of the bishops, barons, and burgesses of the realm, was passed (1296); and before the time of Henry VII., the foundations of parliamentary government had been laid.

The union of the houses of York and Lancaster under Henry VII. begins a new period in English history. Part of his reign was disturbed by Perkin Warbeck and other pretenders to the throne, in support of whose claims the turbulent nobles found vent for their restlessness. But the greater part of his long reign was distinguished from preceding reigns as a time of peace and economy. During it, men's minds ripened for the great events of the next reign. Henry VIII. succeeded, under most favorable auspices. He found the alliance of his now important country courted by both of his great contemporaries, Francis I. and Charles V. But the interest of the foreign complications of the reign merges in the struggle between the courts of E. and of Rome. The origin of the contest was the divorce which Henry desired to have from Catharine of Aragon, his brother's widow, to whom he had been married by papal license. Cranmer and the English Church pronounced the marriage null, but a formal decree of divorce by the head of the church was then thought necessary in Rom. Cath. Europe. Pope Clement and the consistory, influenced by Spanish counsels, delayed, by every possible means, the decision of the question. E., however, was ready enough to support Henry. Wickliffe and his adherents had done not a little to shake the at-

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tachment of the nation to a foreign spiritual authority, by preaching doctrines which dispensed with the necessity for it. A parliament met, when the Commons took the significant step of presenting a long memorial of complaints against the church. The pope still showing no signs of yielding, bills followed, declaring the king the head of the church; rendering the inferior clergy amenable to the civil courts; abolishing the payment of the first year's fruits of ecclesiastical livings to Rome; and perhaps more important than any of these, declaring that no convocation should meet unless the king should summon it, and that no ecclesiastical canons should have force except with the king's consent. To these measures, the pope replied by refusing the divorce, and excommunicating the king (1533). The breach thus became irreparable.

A new act was passed giving to the magistrates the power of judging in questions of heresy. The next step was the suppression of nearly 400 of the smaller monasteries. The subsidence of an insignificant popular reaction, incited by the lower clergy, was followed by the suppression of the great abbeys. All these changes, however, touched only matters of church government. On matters of faith, Henry and his parliaments were as orthodox as the most conservative could wish. They embodied the leading doctrines of Romanism, disputed by the Protestants, in an act of parliament, known among the people as 'the bloody six articles,' and enforced conformity under severe penalties.

Henry was succeeded by Edward VI. His reign was marked by the general progress which the Reformation then made from questions of government to questions of doctrine. More thoroughly than ever the power of the clergy was sapped. The Book of Common Prayer (1548) deprived them of the mysterious authority which the use of a foreign language in worship gave them in the eyes of the people, and the 42 Articles of the Church of England (1552), the foundation of the present 39, denied, among other things, their power to work miracles in the elevation of the mass.

The next reign saw the inevitable reaction. The superstitions of the populace had been too rudely handled, and—as often happens before a crisis—there came a period of physical suffering. The conversion of cornfields into sheep-walks, induced by the high value of wool as an article of export, had thrown many out of employment; and the country was, moreover, infested with the crowd of vagrants whom the monasteries had been wont to maintain. The popular dissatisfaction coupled these things with the Reformation. Thus the opportunity was prepared for the atrocities of the reign of Mary. The queen herself was interested, by her mother's honor and her own, to uphold the Roman faith; and her gloomy temper, aggravated by her unhappy childless marriage, believed that it did true service to God when it gave the rein to the bigotry of Pole and Bonner. In her first parliament (1553), the whole legislation of Edward VI. was repealed, leaving the Church

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of England one in ceremonial and doctrine with the Church of Rome. Another parliament (1555) repealed the legislation of Henry VIII., thus re-establishing the papal supremacy. Everything that the reformers had done was thus undone. Still the adherents of the Reformation were numerous, and when legislation failed to convert them, the fires of Smithfield were tried. Hooper, Bp. of Gloucester, was one of the first to suffer. Latimer, Ridley, Cranmer, followed, and the number who perished was not less than 300 by fire, and 100 by torture and the cruelties of confinement. Nothing more was needed to turn the popular mind at once and for ever from the Church of Rome.

The accession of the Prot. princess Elizabeth came as a relief to the whole nation. The Romanists themselves were weary of the policy which made E. the tool of Spain, and were sickened with the cruelties which had been enacted. Elizabeth began by releasing from prison all confined on charges of heresy. Parliament followed (1559) with acts restoring the royal supremacy over the church, and returning in general to the legislation of Edward VI. The Prayer-book and the Thirty-nine Articles were adjusted as they still remain. Fortunately for the country, the ministry of Elizabeth, guided by the able hand of Cecil, was one of peace. No opportunity was lost of aiding the Prot. cause throughout Europe; but Elizabeth had almost no open wars, and her long reign was disturbed by almost no domestic collisions. The mistake committed in detaining the queen of Scotland in an English prison, gave a constant incitement to disaffection among the adherents of the old faith, but no serious consequences ensued. Toward the close of the reign, Prot. and Rom. Cath. were alike patriotic in repelling the Armada (1588). At the death of Elizabeth, the crowns of E. and Scotland were united.

The reign of James VI. presents little that is remarkable. The plot, for which Sir Walter Raleigh suffered long afterward, and the Gunpowder Plot—the insignificant proportions of which were magnified for factious purposes—disturbed the earlier years; and the close of the reign found the nation engaged in an unfortunate war to assist the king's son-in-law, Frederick, Elector of Bohemia, against Emperor Ferdinand II. of Germany. But for the greater portion of the 23 years of the reign, there was neither foreign nor domestic war. These years the king occupied industriously in rendering monarchy odious and contemptible. He lavished money upon unworthy favorites, and to supply his extravagance, openly sold the dignities of the peerage and the other honors of the state. His personal demeanor was vain, weak, and ridiculous; but in contrast with the insignificance of his talents was his extravagant conception of the extent of his royal prerogative. His conduct occasioned great discontent in parliament, and but for his timidity, might have led to more serious consequences.

The misfortunes of Charles I. were the legitimate result

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of the principles of his father. Charles committed the mistake of repeating, in the 17th c., acts which the Plantagenet sovereigns had done with impunity in the 14th and 15th. One of his first acts was to exact a benevolence to carry on the war. Had the war been successful, this might have been overlooked, but when the bad management of the Duke of Buckingham lost the fleet off Rochelle, the indignation of the Commons was without bounds. In place of taking measures to allay this feeling, the king dissolved the parliament, and resolved to govern without calling another. In 1630, he concluded peace, and for the next seven years, in council with Strafford and Laud, he carried on the government. Taxes were raised as before without parliamentary authority; and when the taxes failed, money was raised by selling to the Rom. Catholics immunities from the penal laws against their worship.

Nevertheless, there were limits to these methods of raising money; and 1637, when the king found himself involved in a war with Scotland, in consequence of his endeavor to introduce a liturgy there, he was compelled to call a parliament. The Commons refused supplies, and were again dissolved. In 1640, the king once more summoned a parliament. He found the temper of the house more indomitable than ever. In place of voting him supplies, they impeached his minister Strafford, and condemned him to death. The Commons then presented a grand remonstrance to the king, embodying all the grievances the nation had suffered since the death of Elizabeth. Matters proceeded from bad to worse, till an open rupture came, and an appeal was made to arms. In 1642, Aug. the king erected his standard at Nottingham, while the rebels took arms under the Earl of Essex. The first conflict was at Edgehill, where the loss on both sides was severe and nearly equal. The fortune of war continued to vary, till at Marston Moor it turned against Charles, and at Naseby, 1645, June, he was finally defeated. After trial and condemnation, he was put to death 1649, Jan. 30.

The government for the next four years was conducted by parliament. Meanwhile, Cromwell was rising into distinction, and power gradually fell from the hands of parliament into those of the military. In 1653, Cromwell was proclaimed 'Protector.' He was now absolute monarch. He governed with a firm hand, and never was E. more respected abroad than during his time. In 1654, he concluded peace with Holland, and employed the gallant Admiral Blake in an expedition against the Spaniards, which ended brilliantly for the English navy. But the nation grew as discontented with the government of Cromwell as it had been with that of Charles. After the death of the Protector 1658, and a short interval during which his son Richard held the office, parliament received with acclamations a proposal from Charles II. to return. In 1660, May, the populace clamored with delight on the royal entry to London of him who, a few years before, had fled from Worcester for his life.

While Clarendon was minister, the government of Charles

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II. was well conducted. A war with Holland was brought to a successful ending in the conquest of New York from the Dutch. On Clarendon's resignation, the government passed into the hands of the ministry known as the Cabal. They were as profligate and as careless as the king himself. A succession of cruelties against the Rom. Catholics, for which the pretended revelations of Titus Oates and his imitators furnished the excuse, betokened rather the wanton temper of the sovereign and the nation, than any zeal for Protestantism. The only act which reflects much credit on any portion of the reign was the passing, 1679, of the *Habeas Corpus* Act, designed more effectually to protect the liberty of the person. Strong efforts were made in parliament after that to pass the Exclusion Bill, the object of which was to exclude the Duke of York, as a Rom. Catholic, from the succession. To the great satisfaction of the king, parliament rejected the bill. In 1681, parliament was dissolved, and Charles II. never called another.

After this there was a change for the worse in the character of the government; from being wantonly indifferent, it became sullenly mischievous. Presbyterians and Nonconformists were excluded from all offices. Among other arbitrary acts, was the recall of the charters of London and many of the other principal cities, which were restored, with diminished privileges, only on payment of heavy fines. Conduct such as this made men more than ever afraid of the succession of the king's brother. A conspiracy to secure the succession to the Duke of Monmouth, an illegitimate son of the king, was formed. Lord Howard betrayed the conspiracy, and among others who suffered death for it were Lord Russell and Algernon Sidney.

When the king died, 1685, James II. succeeded amid universal dissatisfaction. Monmouth's attempt to seize the throne, however, was mismanaged, and failed. The punishment of those who had aided his rising formed an occasion for the perpetration of great cruelties by Jeffreys, then chief justice of England. In the meantime, nothing could be fairer than the king's language. He issued a declaration in favor of general toleration, and announced that the penal laws against Rom. Catholics were no longer to be enforced. A second declaration to the same effect was issued, but he went further, and added to it an order that the clergy should read it in all churches. The Abp. of Canterbury and six bishops presented an address to the throne, humbly setting forth that their duty to maintain the Prot. establishment would not permit them to give obedience to the royal mandate. For this they were indicated as guilty of sedition. The trial of the bishops (1688) was the turning-point of James' career. It created immense excitement, and when the jury returned a verdict of not guilty, even the soldiers joined in the tumultuous rejoicings.

William, Prince of Orange, who had married Mary, the eldest daughter of the king, had long been intriguing with the malcontents. He now landed in E. with a small body of troops. The soldiers, the leading nobles, even the king's

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own children, joining the prince, the king fled to France. Parliament then settled the crown jointly on William and Mary for life. James, with the assistance of Louis XIV., made one effort to regain his throne. He landed in Ireland, where the lord lieut., Tyrconnel, was devoted to his cause, and managed to raise an army. William defeated him at the battle of the Boyne: and the contest was soon terminated by the second flight of James to France. So easily was the great revolution of 1688 effected.

The domestic government of William was marked by his efforts to introduce a general toleration; but of his foreign administration, which led the country into costly wars, it is hardly possible to speak in favorable terms. To reduce the threatening power of France, E., in alliance with Holland and Germany, embarked in a protracted contest. Its termination at the peace of Ryswick, 1697, brought to E. nothing beyond an increase of reputation. William died 1702.

Under Queen Anne, the war with France was renewed, and the Duke of Marlborough's splendid victories of Oudenarde, Blenheim, and Ramilie were achieved. With these the history of E. as a separate state closes. In 1707, the long-wished-for union with Scotland was accomplished; and since that, Great Britain, united under one legislature, as well as under one crown, has a common interest among nations, and therefore a common history.

A table of the English sovereigns is appended, beginning with Alfred, and continued, for convenience, to the present time:

	Began to Reign.	Years of Reign.
ANGLO-SAXON LINE.		
Alfred, king of Wessex.....	871	30
Edward I., king of Wessex, Mercia, etc.....	901	24
Athelstan, king of England.....	925	15
Edmund I.....	940	6
Eadred.....	946	9
Edwy.....	955	4
Edgar.....	959	16
Edward II.....	975	3
Ethelred.....	978	38
Edmund II.....	1016	1
DANISH LINE.		
Canute.....	1017	19
Harold I.....	1036	3
Hardicanute.....	1039	2
SAXON LINE.		
Edward III.....	1041	25
Harold II.....	1066	
NORMAN LINE.		
William I.....	1066	21
William II.....	1087	13
Henry I.....	1100	35
HOUSE OF BLOIS.		
Stephen.....	1135	19
PLANTAGENET LINE.		
Henry II.....	1154	35
Richard I.....	1189	10
John.....	1199	17
Henry III.....	1216	56
Edward I.....	1272	35

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Edward II..	1307	28
Edward III..	1327	50
Richard II..	1377	22

HOUSE OF LANCASTER.

Henry IV.....	1399	14
Henry V.....	1413	9
Henry VI.....	1422	39

HOUSE OF YORK.

Edward IV.....	1461	22
Edward V.....	1483	
Richard III.....	1483	2

HOUSE OF TUDOR.

Henry VII.....	1485	24
Henry VIII.....	1509	88
Edward VI.....	1547	6
Mary.....	1553	5
Elizabeth.....	1558	45

STUART LINE.

James I.....	1603	22
Charles I.....	1625	24
COMMONWEALTH	1649	10

STUART LINE.

Charles II.....	1660	25
James II.....	1685	3

HOUSE OF ORANGE.

William and Mary	1688	14
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STUART LINE.

Anne	1702	12
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BRUNSWICK LINE.

George I.....	1714	18
George II.....	1727	33
George III.....	1760	60
George IV.....	1820	10
William IV.....	1830	7
Victoria.....	1837	64
Edward VII.....	1901	—

ENG'LAND, CHURCH OF: the Episco. Church as established in Eng. For the origin and early history, and an outline of the doctrines and form of government of this church, see ANGLO-CATHOLIC CHURCH: see also AUGUSTINE: DUNSTAN. Till the time of the Reformation, ecclesiastical affairs would be more properly described as the history of the Church *in England*; from that period the Church *of England* dates her existence. She, however, retains so much of antiquity, and her institutions, laws, and formularies are so interwoven with the history of the past, that it would be impossible to have any correct or connected view of them, and of her *connection with the state*, her characteristic feature, without glancing at the leading events between the Conquest and the Reign of Henry VIII. During the three centuries from the Norman Conquest (1066) to the preaching of Wickliffe (1356), her history can be regarded only as a continual struggle between the ecclesiastical and civil power, and there would be little else to describe than the methods by which the mitre triumphed over the crown, and the crown invaded the rights and property of the church. In the time of William I., nearly half the country was in the hands of 'spiritual' persons. He ejected the English clergy, and supplanted them with Normans;

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and though he was possessed of full power over the church, yet in his reign were sown the seeds of future papal encroachments. Papal legates were then first introduced into England, and the ecclesiastical courts separated from the civil. From this time, the increased influence of Rome may be traced to the defective titles, the usurpations, and the violent conduct of the kings. Thus, the defective title of Henry I. made him seek popularity by recalling the primate Anselm, who had incurred the displeasure of his brother William, and had fled the country. Anselm was devoted to the pope, who had espoused his quarrel; and he refused to do homage to the king for the temporalities of his see, till at length Henry found himself obliged to surrender the right of *Investiture*. Thus, too, Stephen's usurpation opened the way for further encroachments; and Henry II., who found the power of Rome greatly augmented, helped to extend it, by accepting a grant of Ireland from the pope. Then followed the opposition of Thomas-à-Becket, which arose out of the question of the punishment of ecclesiastics by the civil power. For the moment, it seemed that the quarrel was healed by the *Constitutions* agreed on at Clarendon (q.v.), but it broke out more violently than ever. The pope discharged Becket from his oath, and condemned the *Constitutions*. Becket had fled from the kingdom; and his subsequent return, murder, and canonization, all tended to strengthen the authority of the church. It was not, however, till the reign of John, when England was laid under an interdict, and the king resigned his crown to the pope, that the papal encroachments rose to their height; and the weak reign of Henry III., which followed, did nothing to abate them. Edward I. gave a check to the power of the clergy, subjected them to taxation, and passed the statute of Mortmain (1279), which prohibited the transfer of land without the king's consent. There is little to be said as to innovations in doctrine during these three centuries; but it may be noted, that about the middle of this period, 1213, the council of St. John Lateran declared transubstantiation, or the bodily presence of Christ in the consecrated elements, a tenet of the church.

In 1356 a new period commenced. Wickliffe then published his first work, entitled *The Last Age of the Church*, directed against the covetousness of the Church of Rome. His doctrines correspond in many points with those now taught by the Church of England, but he differed from her in regard to the necessity of Episcopacy, which he rejected; he believed also in purgatory, and enjoined prayers for the dead. His chief objects of attack were the papal indulgences, and the doctrine of transubstantiation. An English writer has observed concerning the condemnation at Oxford of Wickliffe's opinions with respect to the latter, that 'this was the first plenary determination of the Church of England in the case, so that this doctrine, which brought so many to the stake, had but with us 140 years' prescription before the times of Martin Luther.' In a limited sense, he upheld the efficacy of the seven sacraments. Wickliffe had a large body of followers. They were called

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Lollards, probably from a German word, *lullen*, to sing with a low voice. The storm of persecution which he escaped by death, fell upon them. Henry IV. thought it necessary to fortify his usurped position by assisting the bishops against the Lollards; and from this time to the Reformation, there was an uninterrupted succession of confessors and martyrs. Sir John Oldcastle, Lord Cobham, was the most illustrious of these sufferers. Fox gives a detailed account of nearly 20 persons burned for heresy between the death of Lord Cobham and 1509, when Henry VIII. ascended the throne. To some extent, the blood of these martyrs was the seed of the Reformed Church; but we must not overlook the ‘hidden seed’ which was growing secretly, from the time that Wickliffe gave his countrymen a translation of the Scriptures in their own tongue. The progress of learning, and especially the study of Greek, led to a better understanding of the sacred books, while the invention of printing (1442) caused a wider circulation of them.

The above causes, however, would probably have proved insufficient to produce the great change then impending, had not Henry VIII.’s divorce from Catharine of Spain led to a quarrel between him and the pope, which ended in the total abolition of the papal authority within the kingdom. Then began the REFORMATION in earnest. For the details of that great event see that title, and the lives of such men as Wolsey, Sir Thomas More, Fisher, Clement, Luther, Cromwell, Cranmer, Latimer, and Ridley, etc. From this period may be dated the existence of the Church of England as a separate body, and her final separation from Rome. For the opinions of the church in Henry’s reign, two important books which were then published should be consulted—viz., the *Bishop’s Book*, or the *Godly and Pious Institution of a Christian Man*, and the *King’s Book*, a republication of the same in a more perfect form, 1543, entitled, *The Necessary Erudition for any Christian Man*, and called the *King’s Book* because put forth by royal authority. A book of *Articles devised by the Kinges Highnes Majestie to stablyshe Christen Unitie*, also should be consulted. It has been stated (see ANGLO-CATHOLIC CHURCH) that the reformation in *doctrine* did not make much progress in Henry’s reign; from these books, it will be seen that it was rather retrograde. The monks, too, who were dispossessed at the dissolution of the monasteries, were dispersed among local cures, and kept alive the old opinions, and the lower orders were not as yet favorable to the new doctrines. Cranmer was the leader and presiding genius of the Reformed opinions; and the youth of Edward VI. left the king pliant in the hands of the archbishop. The Book of Homilies, put forth 1540, the New Communion Service and Catechism, 1548, the first Book of Common Prayer, 1549, and the Forty-two Articles, 1553, all bear the impress of his hand, and it was these which advanced and fixed the *doctrines* of the Reformation. Nor was the temporal authority idle on the same side—Bonner and Gardiner were committed to prison, and both were deprived of their bish-

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oprics. In fact, the way in which all the institutions of the Church of England were established in Edward VI.'s reign by the help of the civil magistrate, have brought upon her the charge of Erastianism. The civil power had just delivered her from a foreign tyranny; and when the young king's lack of health, the known sentiments of his successor Mary, the ignorance of the common people, and the interested views of the old clergy, are considered, it cannot be a matter of surprise, still less of blame, that the same arm was relied upon for the establishment of the new forms of religion.

Although Mary promised at her accession that she would put constraint on no person's religion, her promise was broken. Bonner and Gardiner were restored; the Book of Common Prayer and Catechism were declared heretical; the kingdom was reconciled to the see of Rome; a persecution of the chief reformers commenced—Rogers was burned at Smithfield, Hooper at Gloucester, Saunders at Coventry, Taylor at Hadley. The prisons were filled with 'heretics'; many fled beyond sea; some purchased safety by an outward conformity. Cranmer, Latimer, and Ridley perished in the flames at Oxford. Cardinal Pole was made primate. One benefit was conferred on the church by Mary—she surrendered all the church lands, as well as the first fruits and tenths, which had been seized by Henry. At last the death of Mary, with which that of the cardinal was nearly simultaneous, delivered the church from its oppressors. The passing of the *Act of Uniformity* in the first year of Elizabeth's reign, restored the Common Prayer book to general use, and enjoined the same dresses as were in use at the time of the first Prayer-book of Edward VI. All the bishops except one, Kitchin of Llandaff, refused to take the oath of uniformity, and were ejected from their sees to the number of 14 (the 11 remaining sees were vacant by deaths), and 175 other beneficed clergy were deprived for the same cause—no very considerable number, when it is remembered that there were then 9,400 benefices in England. There was some difficulty in filling up the vacant bishoprics, and perhaps some slight informalities. Matthew Parker was made abp. of Canterbury. For the refutation of the fable of the NAG'S-HEAD CONSECRATION: see that title. In 1562, the Thirty-nine Articles were finally reviewed and subscribed. These, with the Book of Common Prayer, are commonly regarded as the tests of orthodoxy in the Church of England.

But what was done to satisfy the scruples of Protestant nonconformists? An attempt in this direction was made in the reign of James I. at the HAMPTON COURT CONFERENCE (q.v.). The result was another review of the Common Prayer-book; and this, with the new translation of the Bible, and the passing of the canons of 1604, were the principal ecclesiastical events of James's reign. These canons received the sanction of the crown, but not that of parliament; they are not, therefore, binding on the laity, but they are still binding on the clergy to some extent, and they regulate the practice of the ecclesiastical courts,

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and are the only rule, on some points, to which the bishops and clergy can appeal. See LAUD: SCOTLAND, CHURCH OF, for the events of Charles I.'s reign. The great rebellion overthrew both church and state. The bishops were declared 'delinquents,' robbed of their property, and abolished; and the clergy were ejected from their benefices. Laud was put to death 1645. The Church of England had no corporate existence during this interval. With the restoration of the monarchy, 1660, came the restoration of the church. The reaction from Puritanism to Prelacy was complete. Attempts were made, but with small success, to win over the Puritan leaders; bishoprics were offered to Baxter, Calamy, and Reynolds; but only the last was accepted. The SAVOY CONFERENCE (q.v.) was an unsuccessful, perhaps insincere, attempt to comprehend the nonconformists in the Established Church. But the demands of the Presbyterians were most immoderate. Baxter went so far as to propose the substitution of an entirely new book of his own hasty composition, in the place of the Common Prayer-book. After the failure of the Savoy Conference, this book was once more reviewed; and a new Act of Uniformity, 1662, made its use, as it now stands, compulsory in all the churches.

The Church of England passed through one more critical period before reaching that tranquillity in which, for upward of a century, she slumbered too securely. In 1687, James II. published the famous Declaration of Indulgence, which filled up the measure of popular discontent, and finally cost him his crown. Although by this declaration, which was perfectly illegal, liberty of conscience was permitted to all his subjects, it was clearly understood that the liberty was intended only for the papists. The nonconformists refused to accept the treacherous boon. Eighteen bishops out of twenty-five refused to publish the declaration, as ordered, in their dioceses. Seven of them—Sancroft, Lloyd, Ken, Turner, Lake, White, and Trellawny—drew up a remonstrance to the king; they were summoned before the privy-council, and sent to the Tower. The whole city was in commotion; and great was the rejoicing when, on being brought to trial in Westminster Hall, they were acquitted. On Nov. 5 following (1688) the Prince of Orange landed in England. It is worthy of remark, that out of these seven bishops three refused to swear allegiance to him, and were joined by a considerable number of the clergy; these were called Nonjurors. In the first year of William and Mary's reign, the Toleration Act was passed, and dissent ceased to be illegal. Another attempt was made to comprehend the nonconformists in the church, but the lower house of convocation was in no tolerant mood, and the attempt failed, but chiefly in consequence of the disturbances in Scotland. In 1717, convocation was dissolved. After slumbering for nearly 140 years, it was once more called into life and action in the province of Canterbury, 1853, under the ministry of the Earl of Aberdeen, and a few years later the Convocation of York also took advantage of the liberty accorded by

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the crown on the advice of this government: see CONVOCATION.

That the Church of England, after fighting for its very existence against popery on the one hand, and against Puritanism on the other, should have subsided into inactivity during the dull reigns of the Georges, is less a matter of surprise than of regret. The peaceful enjoyment of her temporalities in a dull, irreligious, not to say infidel age, may easily account for, though it cannot excuse, her idleness. But that in the rise of John Wesley, 1730, she should have failed to see a grand opportunity for herself, is a matter of both surprise and regret; she, however, let it pass. Such opportunities are rare in history. The next important event in the history of the church is the Act of Union, which came into effect, 1801, Jan. 1, uniting the Churches of England and Ireland in all matters of doctrine, worship, and discipline. The Reformation had made some progress in Ireland under Edward VI. Five Prot. bishops were appointed 1550, and the English Bible and Liturgy were introduced 1551; but from a variety of causes the Reformed doctrines have never found much acceptance with the native population; and though a Prot. Church was established by law, it was and is the church of the minority (see IRELAND). In 1635 the English Articles were received; and in 1632, the English Book of Common Prayer was adopted by convocation. Before the political union of the countries, the two churches were in full communion. By an act of the imperial parliament, 1833, ten of the Irish bishoprics were suppressed, and the funds thus obtained were applied to the augmentation of small livings and the building and repair of churches. There are now 12 Irish bishops. But in 1869, the Irish Church was disestablished and disendowed; and this branch of the Anglican community now stands in much the same relation to the Church of England as does the Episcopal Church in Scotland.

In later times, three great controversies have shaken the English Church, which have led to some great reforms, some internal divisions, and the secession of some members to Rome, and of a few to the ranks of dissent. These were the Tractarian, the Gorham, and the Essays-and-Reviews controversies. The former was occasioned by some Tracts whose publication began at Oxford 1833, with the object of reviving something of the spirit of catholic antiquity, and reforming the abuses and slovenly practices which had crept into every part of the church system: see TRACTARIANISM. The Gorham Controversy (q. v.) related to the doctrine of baptismal regeneration. The Tractarians are accused of Romanizing tendencies; and their views, when carried to extremes, undoubtedly lead in that direction, as is proved by the numerous secessions to that church. With the extreme Low Church party, Episcopacy is rather an expedient than a necessary form of church government. They think little of the efficacy of sacraments, in their outward form, and deny that regeneration necessarily takes place in infant baptism. Justification by

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faith, the atonement of the cross, and doctrines of at least a Calvinistic tinge on election, are their leading topics in preaching. See SIMEON: VENN.

The Essays-and-Reviews controversy (so called from a book thus named) concerned what are called BROAD CHURCH views, attributed to men of the Thomas Arnold school, and the followers of Mr. Maurice (q.v.). Those who hold them can scarcely be called a party, and are, indeed, unwilling to be so considered; but if their position must be defined, they might be described as a party between, and somewhat antagonistic to, both the High and Low Church parties. The High Church party insist on the authority of the church and priesthood, the efficacy of sacraments when rightly received, and the necessity of apostolical succession in the matter of orders, and in their general teaching they take the Prayer-book as the exponent of Scripture. They are scrupulous in observing the rubrics, and have done much to revive the practice of daily prayer in the churches, and the observance of the festivals. Order, unity, antiquity, and catholicity are what they profess to have in view. See RITUALISM.

In 1901 there were 2 abps.; 33 bps.; 26 suffragan bps.; 31 deans; 91 archdeacons; 132 residential canons; 810 rural deans; 13,894 beneficed clergy; 7,400 unbeneficed clergy; 7,061,559 church sittings; 36 dioceses; 11,960 schools with 2,004,493 pupils, 30 training colleges, for school teachers, toward maintenance of which the church contributes \$50,000 annually. The abps. and 24 bps. have seats in the house of lords. The revenues of the church from endowments in tithes, land, etc., amount to between \$20,000,000 and \$30,000,000 annually; and the amount annually raised by voluntary means averages, for church building and restoration, \$5,000,000; foreign missions, \$2,700,000; elementary education, \$2,640,000; and home missions, clubs, charities, \$2,500,000. In 1901 the church revenue was £5,542,394, and mission revenue £2,235,-741. The voluntary contributions for church work amounted to nearly £8,000,000. For administrative and supervising purposes the country is divided into two provinces, presided over by abps.; these are subdivided into dioceses with a bp. for each; the dioceses are divided into archdeaconries with an archdeacon for each; the archdeaconries comprise the rural deaneries; and these are subdivided into parishes, in charge of the minor clergy. The church govt. is by bps., priests, and deacons. The cathedrals, prelates, and date of their preferment are (1902): Canterbury, Temple, 1896; York, Maclagan, 1891; London, Ingram, 1901; Durham, Moule, 1901; Winchester, Davidson, 1895; Bangor, Williams, 1899; Bath and Wells, Kennion, 1894; Bristol, Browne, 1897; Carlisle, Bardsley, 1892; Chester, Jayne, 1888; Chichester, Wilberforce, 1895; Ely, Compton, 1886; Exeter, Ryle, 1901; Gloucester, united with Bristol under 1 bp.; Hereford, Percival, 1895; Lichfield, Legge, 1891; Lincoln, King, 1885; Liverpool, Chavasse, 1900; Llandaff, Lewis,

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1883; Manchester, Moorhouse, 1886; Newcastle, Jacob, 1882; Norwich, Sheepshanks, 1893; Oxford, Paget, 1901; Peterboro, Glyn, 1896; Ripon, Carpenter, 1884; Rochester, Talbot, 1895; St. Alban's, Festing, 1890; St. Asaph, Edwards, 1889; St. David's, Owen, 1897; Salisbury, Wordsworth, 1885; Sodor and Man, Stratton, 1892; Southwell, Ridding, 1884; Truro, Gott, 1891; Wakefield, Eden, 1897, and Worcester, Gore, 1902.

The patronage of the church is in a great variety of hands—in the crown, the bishops, the nobles, and gentry, and incorporate bodies such as colleges and cathedrals. Advowsons and next presentations may be sold as property, but a presentation may not be sold when a living is vacant. A clergyman is 'presented' to his living by the patron; he is admitted and inducted by the bishop or his appointee; he must 'read himself in,' i.e., he must read the Thirty-nine Articles after the morning or evening prayer within two months after induction. The bishop may refuse institution on the ground of false doctrine or immorality; but an appeal lies to the Arches Court and the Head Court of Appeal.

The Episcopal Church in Scotland is not, politically speaking, in union with that of England. But an act of parliament, 1864, has taken away many restrictions imposed on Scottish Episcopalians after the battle of Culloden; and clergy ordained by Scotch bishops may now, under some slight restrictions, be presented to benefices in England. Events connected with the colonies have also drawn these two communions into closer alliance; and some bishops, selected by English authorities for foreign parts, have been consecrated in Scotland.

See the works on the history of the Church of England by Dixon, Molesworth, Hoare, J. H. Blunt, J. J. Blunt, Perry and Short, Marsden and Hardwick; also Fuller's *Church History*, Collier, Strype, Mosheim, Burnet, and Clarendon. Among the great divines whose works should be consulted for further information regarding the views of the church, are Barrow, Pearson, Hooker, Jeremy Taylor, Lightfoot, Hammond, Sancroft, South, Tillotson, Bp. Butler, Atterbury, Bull, Sherlock, and others. See EPISCOPACY: EPISCOPAL CHURCH, PROTESTANT.

ENGLAND, FREE CHURCH OF: see FREE CHURCH OF ENGLAND: also, EPISCOPAL CHURCH, REFORMED.

ENGLAND, *Ing'lnd*, JOHN, D.D.: 1786, Sep. 23—1842, Apr. 11; b. Cork, Ireland: Rom. Cath. bp. He studied law two years, entered the Rom. Cath. Theol. College at Carlow 1803, founded an asylum for unprotected females, and several free schools for the education of poor boys, and was recalled by his bp. and appointed pres. of the theol. seminary at Cork 1808. Subsequently he became lecturer at the North Chapel, chaplain of the prisons, and proprietor and editor of the *Chronicle*. He was consecrated first bp. of the see of Charleston (S. C.) in Cork 1820, and entered on his duties the same year; founded the *Catholic Miscellany*, the first Rom. Cath. journal in the United

ENGLAND, NEW—ENGLISH.

States; established a classical school for training a body of missionaries for his large see (N. C., S. C., Ga.); reopened the College of Charleston; established Ursuline schools and orphan asylums, boarding schools, and free schools under charge of the Sisters of Our Lady of Mercy; convened the first provincial council of Rom. Cath. prelates in the United States; and was the first Rom. Cath. clergyman invited by congress to preach in its hall. He was well esteemed by those of other communions than his own.

ENGLAND, NEW: see NEW ENGLAND.

ENGLANTÉ, āng-glāng-tā, in Heraldry: bearing acorns or similar glands.

ENG'LE, FREDERICK, U.S.N.: 1799–1868, Feb. 12; b. Delaware co., Penn.: rear-admiral. He was appointed midshipman 1814, commissioned lieut. 1825, commander 1841, capt. 1855, rear-admiral 1866, and was retired 1866, July 25. He commanded the *Princeton*, of the blockading squadron during the Mexican war, brought the frigate *Hartford* home from China at the beginning of the civil war, and became commander of the navy-yard at Philadelphia and subsequently gov. of the naval asylum there.

ANGLEWOOD, ēng'gel-wūd: a city in Bergen co., N. J.; on the Northern N. J. railroad; 1 m. w. of the Palisades of the Hudson river, 14 m. n. of N. Y.; set off from Hackensack 1871. Beautifully located, a place of attractive homes; has 5 churches, a classical institute, several hotels, and a weekly newspaper. Pop. (1900) 6,253.

ENGLISH, īng'glīsh: first part in several geographical names.—ENGLISH COVE, bay of the Pacific Ocean, on the s.w. coast of New Ireland, lat. 4° 54' s., and long, 152° 35' e.—ENGLISH HARBOR, on the s. side of Antigua: one of the best havens in the W. Indies; lat. 17° 3' n., and long. 61° 45' w.—ENGLISH HARBOR, on the Pacific shore of Costa Rica, Central America; lat. 8° 50' n., and long. 83° 55' w.—ENGLISH RIVER, estuary in Africa, on the w. side of Delagoa Bay, an inlet of the Indian Ocean; about lat. 25° 58' s., and long. 32° 36' e.—ENGLISH RIVER: see CHURCH ILL RIVER.

ENGLISH, a. īng'glīsh [AS. *englisc*—from *Angles* or *Engles*, an anc. tribe of Germans who settled in England]: of or pertaining to England: N. the people of England and its language: V. to translate into the English language. EN'GLISHED, pp. -glīshi. EN'GLISHRY, n. -rī, state or privilege of being an Englishman; in anc. laws, called *Engleshery*, *Englyscherie*, etc. Note.—The ANGLES came from the s.e. of Sleswick, Denmark—the majority of the settlers in Britain were from *Anglen* or *Angeln* (see ANGLES), and neighborhood, hence *Engla-land*: AS. *enge*, narrow, as descriptive of the isthmus between Denmark and the Continent: see ANGLO-SAXON LANGUAGE AND LITERATURE: ANGLO-SAXONS: ENGLISH LANGUAGE: ENGLISH LITERATURE.

ENGLISH, EARL: naval officer; b. Crosswicks, N. J., 1824, Feb. 18—1893, July 16. He was appointed a midship-

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man in the U. S. navy 1840, and after a cruise of 4 years round the world entered the Naval Acad., from which he graduated 1846. During the Mexican war he was on duty on the Pacific coast, and was present at the capture of Mazatlan, 1847. He was afterward engaged in deep-sea soundings in the Atlantic, on board the *Dolphin*, and was in the China war 1857, when he was wounded. In 1862 he was promoted lieut-commander, and during the greater part of the civil war was on duty in the Gulf of Mexico, and commanded, at different periods, the *Somerset*, *Sagamore*, and *Wyalusing*. He was promoted commander 1866, capt. 1871, commodore 1880, and rear-admiral 1884, and was retired 1886. In 1868 he gave refuge to the defeated tycoon of Japan on the *Iroquois* at Osaka.

ENGLISH, JAMES EDWARD: 1812, Mar. 13—1890, Mar. 2; statesman; b. New Haven, Conn. His education was only that of the common schools, and for a time he was apprenticed to a carpenter, from which position he rose to be a master-builder; then engaged in the lumber trade and other lines of business until he became one of the wealthiest men in Conn. From 1848, he held a number of official positions in the state; and was elected to congress as a war democrat, serving 1861–65. He was elected U. S. senator 1875, to fill a vacancy, and was gov. of Conn. three times.

ENGLISH, *ing'glīsh*, THOMAS DUNN, poet: b. Phila. 1819, June 29; d. 1902, April 1. Graduated at the medical dept. of the Univ. of Pa. 1839, studied law and was admitted to the bar 1842, became editor of a daily newspaper in N. Y. 1844, lived in Va. 1852–58, and settled in N. J. 1859, where he afterward practiced law, medicine, and journalism, and served in the legislature. He was author of numerous novels, more than 20 dramas, and many poetical, satirical, and literary works. His best known poem is the song *Ben Bolt* (1843), and his latest works are *American Ballads* (1882), and *Book of Battle Lyrics* (1886). He received the degree LL.D. from William and Mary College 1876, and was in congress 1891–5.

ENGLISH, WILLIAM HAYDEN: 1822, Aug. 27—1896, Feb. 7; lawyer; b. Lexington, Scott co., Ind.; son of Elisha G. E., a pioneer. After passing through the common schools, he finished his education at Hanover Coll., studied law, and was admitted to the bar and to practice in the U. S. supreme court before he was 23 years old. Prior to this he had been deputy clerk of Scott co., and postmaster of Lexington, and at the age of 21 he was a principal clerk in the state house of representatives. He was sec. of the state convention of 1850, which framed the constitution of Ind., and after its adoption (1851) was a member of the first house of representatives. During Polk's administration, E. was a clerk in the U. S. treas. dept., and in 1850 a clerk in the U. S. senate. He served in congress as a democrat 1853–61, and also as a regent of the Smithsonian Inst., Washington. In 1880, he received the unanimous nomination of the democratic national convention for vice-pres., on the ticket with Gen. Hancock.

ENGLISH CHANNEL—ENGLISH DRAMA.

ENGLISH (or BRITISH) CHAN'NEL (*La Manche* or the *Gleeve* of the French, and the *Oceanus Britannicus* of the Romans): narrow sea which separates England and France, having on the n. the English counties Kent, Sussex, Hants, Dorset, Devon, and Cornwall; and on the s. the French depts. Pas de Calais, Somme, Seine Inférieure, Calvados, Manche, Ille-et-Vilaine, Côtes du Nord, and Finisterre. On the e. it joins the North Sea, at the Strait of Dover, where it is narrowest, being only 21 m. wide from Dover to Cape Grisnez near Calais. From this strait its course is w.s.w. for 280 m. joining the Atlantic Ocean at the Chops, with a breadth of 100 m. between the Scilly Isles and Ushant Isle. With an average breadth of 70 m., it is 90 m. wide from Brighton to Havre; 60 m. from Portland Point to Cape La Hague; 140 m.—its greatest breadth—from Sidmouth to St. Malo; and 100 to 110 m. w. of the latter line. It occupies 23,900 sq. geographical miles, and includes the Scilly Isles, Channel Isles, Ushant Isle, Isle of Wight, and many islets and rocks, especially off the coast of Bretagne. It is shallowest at the Strait of Dover, where a chalk-ridge at the depth of 12 to 30 fathoms extends from the English to the French shore. West of this, it deepens to 60 fathoms, with some banks at 3 to 5 fathoms, and some hollows 5 to 39 fathoms deeper than the parts around. A coarse gravel covers the bottom. The English coast-line of the E. C. is 390 m. long, with an inshore depth of 12 to 55 fathoms, and the French coast line of the E. C. is 570 m. long. Westerly winds prevail in the E. C., and the current, though imperceptible, is always from west to east. The E. C. abounds in fish, of which the chief are pilchard, mackerel, and oysters.

ENGLISH CONSTITUTION: see PARLIAMENT.

ENGLISH DRAM'A: see DRAMA.

ENGLISH LANGUAGE.

ENG'LISH LAN'GUAGE: originating in England, now spoken by abt. 100,000,000 of the earth's inhabitants, and extending in the area of its use. In its vocabulary it is one of the most heterogeneous that ever existed; a fact whose causes are traceable in the history of England (q.v.). Its composition and grammatical character are thus described by M. Müller, *Lectures on the Science of Language* (1861). ‘There is, perhaps, no language so full of words evidently derived from the most distant sources as English. Every country of the globe seems to have brought some of its verbal manufactures to the intellectual market of England. Latin, Greek, Hebrew, Celtic, Saxon, Danish, French, Spanish, Italian, German—nay, even Hindustani, Malay, and Chinese words—lie mixed together in the English dictionary. On the evidence of words alone, it would be impossible to classify English with any other of the established stocks and stems of human speech. Leaving out of consideration the smaller ingredients we find, on comparing the Teutonic with the Latin, or Neo-Latin, or Norman elements in English, that the latter have a decided majority over the home-grown Saxon terms. . . . M. Thommerel, who counted every word in the dictionaries of Robertson and Webster, has established the fact, that the number of Teutonic or Saxon words in English amounts to only 13,230 against 29,853 words which can either meditately or immediately be traced to a Latin source. On the evidence of its dictionary, therefore, and treating English as a mixed language, it would have to be classified together with French, Italian, and Spanish as one of the Romance or Neo-Latin dialects. Languages, however, though mixed in their dictionary, can never be mixed in their grammar. . . . We may form whole sentences in English consisting entirely of Latin or Romance words; yet whatever there is left of grammar in English bears unmistakable traces of Teutonic workmanship. What may now be called grammar in English, is little more than the terminations of the genitive singular and nominative plural of nouns, the degrees of comparison, and a few of the persons and tenses of the verb. Yet the single *s*, used as an exponent of the third person singular of the indicative present, is irrefragable evidence that in a scientific classification of languages, English, though it did not retain a single word of Saxon origin, would have to be classed as Saxon, and as a branch of the great Teutonic stem of the Aryan family of speech.’ See LANGUAGE.

In tracing the growth of the English language, the history is usually divided into four leading periods: the *Anglo-Saxon Period* (A.D. 440–1066); the *Semi-Saxon Period* (1066–1250); the *Early English Period*, comprising the two periods of *Old* and *Middle English* (1250–1550); and the *Modern English Period* (1550 to the present time). But this nomenclature and these divisions are now impugned by an increasing number of scholars, who affirm, not without reason, that English was always English, and never ‘Anglo-Saxon;’ that the fact of its being inflected in the period before the Norman Conquest, and losing most of its

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Inflections in later times, is no reason at all for speaking of it as if it were two or even three different languages, and that we have no warrant in the usage of the inflected period for calling our forefathers or their speech anything but English. It is certainly very misleading to name the period immediately succeeding the Conquest *Semi-Saxon*, because it induces people to imagine that the so-called 'Saxon,' that is, the English, element of our language had begun to be mixed up with foreign ingredients, though, in fact, its two great monuments, *The Chronicle*, and Layamon's *Brut*, are almost absolutely free from such. It is probable, therefore, that the old divisions and their designations will before long be abandoned, and they are retained here only because of a usage which has penetrated modern English literature. See ANGLO-SAXON LANGUAGE AND LITERATURE.

As early as the 5th c., Teutonic invaders from the continent settled in this country, and drove the original Celtic-speaking inhabitants to the n. and w. of the island; so that before the battle of Hastings (1066), the tongue of the 'Teutonic conquerors had been spoken in England for at least 600 years. The final absorption, after numerous conflicts, by the kings of Wessex, or West Saxons, of the various states of the 'Heptarchy,' in the 9th c., went far to make the ruling speech of the land identical with that of Berkshire and Hants, the recognized centre of the predominant sept. The use, besides, of this Southern Anglo-Teuton speech as the chief instrument of literary communication, was permanently confirmed by the influence of King Alfred, a native of Berks. Further back than the time of this literary monarch, we are enabled or permitted to go by only a few existing remains of the language; yet, from the writings of Cædmon, a North Anglian, and a few ecclesiastical MSS. of the kingdom of Northumbria, which extended from the Humber to the Firth of Forth, it has been generally concluded that at least two dialects must have been used in the island—a northern and a southern one. The Anglian or Northern dialect was, to some slight extent, marked by Scandinavian features; while the Saxon or Southern dialect was more purely Low-Germanic, though the Anglian also was Low-German in all essentials. Some have accounted for the partial approximation of the Anglian dialect to Scandinavian by the fact that the Danes, at a later period, effected a settlement in the n.e. of England; but, on the other hand, it is argued that 'certain peculiarities of a Scandinavian character are to be found in the Anglian, even of a date anterior to the first Danish occupation of a part of England, in the latter half of the ninth century.' Nor would this be at all surprising if we admit that the Angles came from that corner of Slesvig still called 'Angeln,' or indeed from any region n. of the Elbe. Some philologists, again, insist on distributing the Anglo-Saxon language into more dialects than two; but it will be sufficient if the reader bear in mind the two above mentioned. It is important to notice here that neither the Anglian nor the Saxon borrowed anything appreciable

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from the language of the conquered Britons; in other words, English is very nearly free of any Celtic element. On the other hand, a considerable, but not large, number of Latin words found their way into the English vocabulary before the Norman Conquest, through the introduction of Latin Christianity, and the translation of Latin authors into English.

The period in the history of our English tongue incorrectly described as *Semi-Saxon*, because the inflections that marked the earlier stage then began to give way, dates from a generation after the Conquest until near the middle of the 13th c. Like every transition era, it was a period of confusion, both to those using the language, and to those desirous of tracing its history. The monks of the time, accustomed to the use of mediæval Latin, had in a great measure forgotten the grammar of their native language; and when they attempted to write it, did so very badly. The *Chronicle*, which in its latest form comes down to 1154, and Layamon's *Brut*, written about 1190 or 1200, show traces of the breaking up of the grammar. The inflections and genders of the substantives, the definite and indefinite declensions of adjectives, are for the most part disregarded; a marked partiality is shown for weak preterites and participles; there is a constant substitution of *en* for *on* in the plurals of verbs; and the final *e* is often discarded; besides a great uncertainty prevailing in the government of prepositions. As regards the vocabulary itself, though employed in literature a century and a half after the Norman Conquest, it shows, as already noticed, but few traces of Norman-French (only 90 words in 57,000 verses); proving beyond question that the immediate effects of that great change were by no means so important on the English tongue as they were at one time believed to be.

When we come to the *third* period in the history of English, commonly called *Early English*, we have escaped most of the perplexities which attach themselves to the previous stage of the language. The tendency of the language to substitute an *analytical* for a *synthetical* structure is now seen vigorously at work. The 'Anglo-Saxon' was moderately rich in inflections, which are now largely discarded. The various modifications of an idea are expressed by some relational word or words attached to the leading idea. During the second or semi-inflected period, the verbs suffered much less inflectional change than the substantives and adjectives; this will be found to hold throughout the entire 250 years of the era of reconstruction. In the fine poem of *The Owl and the Nightingale*, the Anglo-Saxon vowels *a*, *e*, *u*, in final syllables, all are represented by *e*, and the final *n*, of the infinitive is beginning to disappear. In the Chronicle of Robert of Gloucester, we encounter, besides, a great number of French words (Dr. Marsh found 4 per cent. in 10 pages), which had gradually become familiar to the people, through the presence of their Norman masters, and through the efforts of the latter to speak English after it was found impossible to supplant it by Norman French. The presence of French is, besides, very

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noticeable in the poetry of Chaucer and Gower; but there is no ground for the statement that these writers corrupted the language by a large admixture of novel French words. Dr. Morris is quite correct when he says (introduction to Chaucer's *Prologue*, etc., Clarendon Press series), that Chaucer, 'with few exceptions, employed only such terms as were in use in the *spoken* language, and stamped them with the impress of his genius, so that they became current coin of the literary realm.' And Mr. Skeat remarks (introduction to *Piers the Plowman*, same series) that 'Langland does the very same thing, employing Norman-French words freely whenever he wishes to do so.' As to Scotland also, in the Anglian counties lying s. of the Forth, and as far n. of it as English had got a footing, the language underwent such changes as we have noted in the more southern dialects. Barbour, Scottish contemporary of Chaucer, wrote purer English than Chaucer did, only because he used less French. Regarding the n.e. dialects of Scotland, indeed, some diversity of opinion exists. Some antiquaries are of opinion that the large infusion of Norse or Scandinavian elements in these dialects is to be accounted for by the fact of a Norwegian kingdom having been maintained there more or less from the 9th to the 11th c.; while others allege that the language of the n.e. of Scotland is in substance and grammar as decidedly Anglian as that of Norfolk or Yorkshire.

We may here notice the question which has often been asked: Which of the early dialects spoken in England is the origin of the form now used? We have seen that in the pre-Norman period *two* were employed for literary purposes, a Northern or Anglian, and a Southern or Saxon, the latter of which, through political causes, was perhaps considered the more classical of the two. In the period, however, succeeding the Norman conquest, and especially after 1250, we find not *two* but *three* dialects; a Northern, a Midland, and a Southern. The cause of this was probably the breaking up of the supremacy of Wessex after the battle of Hastings. Circumstances now gave prominence to the Midland counties, in which arose the great universities, the rich monasteries, and many other religious foundations. One of the subdivisions of the Midland dialect, the east Midland, was that dialect in which Orm, Robert of Brunne, Wycliffe, Gower, and, above all, Chaucer wrote. It had then become the speech of the metropolis, and had probably forced its way s. of the Thames into Kent and Surrey. This, therefore, may be considered the immediate parent of modern English, but inasmuch as the Midland gathered into itself from its very position many of the peculiarities of the dialects spoken n. and s. of it, Sir Frederick Madden's view (*Layamon's Brut*, 1851), that we must look for the real groundwork of modern English in a gradual coalescence of the various dialects, may still be considered substantially correct.

ENGLISH LITERATURE.

ENG'LISH LIT'ERATURE: written works of the English people; like every other mental product, it is qualified by the national history. The great social eras of a country's history have always been found to correspond with the great intellectual eras of her growth. It will, however, be sufficient for the present purpose to arrange the literary annals of England into three periods: 1. The period antecedent to the Norman Conquest; 2. The period from the Norman Conquest to the English Reformation; 3. The period from the English Reformation to the present day.

1. *The Period antecedent to the Conquest.*—This period possesses a literature in three distinct languages—the *Celtic*, the *Latin*, and the *English*. Regarding the Celtic literature, see CELTIC NATIONS: IRISH LITERATURE; WELSH LITERATURE. The introduction of Latin literature into this country was considerably later than the Roman invasion. The cultivation of the letters of Rome followed as a necessary consequence on the introduction of Christianity into the country. Toward the close of the 6th c., St. Augustine landed in the s. of England, and laid the foundations of the Anglo-Catholic Church. The great evangelists of that time, however, rather prepared the way for literary effort on the part of others, than were themselves literary. The earliest names recorded are Gildas, Nennius, Bede, Alcuin, Asser, and Erigena. After the immigration of the Angles and Saxons into Britain, this people began to form a literature of their own: see ANGLO-SAXON LANGUAGE AND LITERATURE. Their three historical poems—the Gleeman's Song, the Battle of Finnesburgh, and the Tale of Beowulf (q.v.)—are mainly versions of events which happened on the continent before the descent on the shores of England. Except the remarkable religious poems of the Northumbrian monk Cædmon, in the 7th c., little more of any moment in verse has been handed down to us by the English people who lived before the Conquest. But this people, though comparatively poor in poetry, are eminently simple and straightforward prose writers. King Alfred discarded Latin in all his communications with his subjects, and in consequence the native language made an impressive start through the whole of England. From the *Chronicle*, made from the M.S. of several conventional records, modern scholars have derived special and valuable information. Portions of the sacred Scriptures were translated into English, several of the leading men of the time, such as Aldhelm, Bede, and Alfred, lending their assistance. Sermons and grammars, glossaries and medical treatises, geographies and dialogues between Solomon and Saturn, make up the file of this period of the literature.

2. *The Period extending from the Norman Conquest to the English Reformation.*—The Conquest had the effect of changing the language of the court, the schools, and the tribunals of justice; it took but little effect on the native inhabitants. In a few centuries, owing partly to the obstinacy with which the English people clung to their mother tongue, and partly to the circumstance that long settlement

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in England and political antagonism to France had practically changed the descendants of the Norman conquerors into English nobles, and inspired them with English feelings, the latter began to abandon the use of French. 'In 1349, boys ceased to learn their Latin through the medium of this tongue; and in 1362 (the 36th year of Edward III.), it was directed by act of parliament that all pleadings in the law-courts should henceforth be conducted in English, because, as it stated in the preamble to the act, French was become much unknown in the realm' (Morris's *Historical Outlines of English Accidence*, 1872). In a generation or two after the Conquest, classical and theological learning made considerable progress. Monasteries were busy, and both the English universities were by this time founded; while an interchange of teachers and pupils constantly went on between the English seminaries and those of France and other countries. Lanfranc and Anselm, Hales and Duns Scotus, Michael Scot and Roger Bacon, had attained great eminence in speculative and in physical philosophy. Doubtless their thinking was characterized more by its hair-splitting ingenuity than by its solidity, but the 12th and 13th c. stand out in a distinguished manner in England, and indeed throughout Europe, for their peculiar devotion to speculative studies. But all these philosophers wrote in Latin, as did the historical writers of the same period, of whom the chief were William of Malmesbury, Geoffrey of Monmouth, Giraldus Cambrensis, and Matthew Paris. A literary feature of the age which must not be overlooked was the frequency of satire in rhymed Latin verse. The most notable of the mediæval satirists was Walter Mapes, to whom is ascribed (though evidence of authorship is not conclusive) certain clever half-scurillous poems, from one of which, the *Confessio Goliæ*, have been extracted a number of verses, commonly but erroneously spoken of as a 'drinking-song' (see MAPES). The satire passed from the clergy, and was directed against the feeble King (John). De Montfort and the other great barons who distinguished themselves at Runnymede, are the theme of popular praise. In the same Latin tongue was composed the oldest legendary work of the Middle Ages. The *Gesta Romanorum* (q.v.) is a compilation of uncertain origin. The stories themselves are in many cases of great antiquity, and in their earliest forms can be traced to the distant East. In their Latin dress they were the property, not of England only, but of all Western Christendom, and their only claim to notice in a special survey of English literature arises from the fact that their editor, Elinandus, was perhaps an Englishman, and that they have furnished (at second or third hand) incidents and plots to the genius of Shakespeare and Scott. In the same relation to English literature stands *The Seven Wise Masters*, traceable back to India, but known to all Western Europe in a Latin form, and to England in particular under the title of the *Process of the Sevyn Sages*. The French Fabliaux affected English literature but little before the time of Chaucer. On the other hand, the romances of chivalry, rude and spir-

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ited, pathetic and imaginative, are well worth the attention of the student of English literature. The best of these, written first in French, afterward translated into English, celebrate the glory and fall of King Arthur and his knights of the Round Table, of which splendid use has recently been made by Alfred Tennyson in his *Idylls of the King*.

Meanwhile the English tongue was undergoing those serious grammatical and phonetic changes to which reference has already been made. During this half-chaotic stage it was scarcely fit to be a vehicle of literary expression, even if the ignorance and helplessness of the conquered people had not of themselves been sufficient to prevent the growth of a vernacular literature. The first indication of reviving life is the appearance of Layamon's *Brut* (see LAYAMON) about the close of the 12th c. The next century is comparatively rich in writers who use the English tongue, and whose works, if not masterpieces of artistic skill, are at least invaluable for linguistic purposes. The most important of these writers are Orm, Guildford, and Robert of Gloucester.

The period of what is called *Early English*, embracing the 14th and 15th c. is of great importance in the progress both of English history and of English literature. The translation (first ever executed) of the Bible into English, completed by Wycliffe about 1380, is a work of great value, not only as a monument in the religious history of the nation, but in a philological point of view, being, as it is, almost the first among the prose-writings in that form of the English tongue now in use. The principal book which precedes it, and the very oldest written in 'Early English,' is Sir John Mandeville's account of his eastern travels (1356). Somewhat later (1390-1400), Geoffrey Chaucer, genuine father of English poetry, published his *Canterbury Tales*. A shrewd and sagacious observer, he has left behind him in these *Tales* a series of sportive and pathetic narratives, told with such wonderful tenderness and humor, in such a simple, healthy style (though his vocabulary is largely modified by French, and is not a 'well of English undefiled'), that they have been the wonder and delight of all succeeding times. Laurence Minot, Richard Rolle, Langland, author of *Piers the Plowman*, and Gower, fitly close round Chaucer as contemporaries who wrote more or less vigorous verse. About the same period lived in Scotland John Barbour, whose epic narrative, *The Brus*, written about 1376 is incomparably the greatest of all the metrical chronicles. In the following c. (the 15th), and in the early part of the 16th, occur in England the names of John Lydgate (1430), whose *London Lyckpeny* is still agreeable reading; Alexander Barclay, whose *Ship of Fools* was printed 1509; John Skelton, author of the scurrilous satires of *Colin Clout* and *Why Come ye not to Court?* (died 1529); Howard, Earl of Surrey (beheaded 1546-7), who wrote the first sonnets and the first blank verse in the English tongue; and Sir Thomas Wyatt (died 1541). The prose-writers of this period are Sir John Fortescue, chief-justice of the King's Bench under Henry VI., who lived

1430-70, and who wrote, among other things, a tract on the *Difference between an Absolute and Limited Monarchy, as it more particularly regards the English Constitution*; William Caxton, who introduced printing into Britain 1477—the first book ever printed in this country being a translation of the French work *Le Recueil des Histories de Troye*; Sir Thomas Malory, whose *Morte Darthur* (1469-70) is the final form of the old Arthurian romance; Hall, English lawyer (died 1547), who wrote a chronicle of the *Wars of the Roses*; and Tyndale (burned 1536) for heresy. In Scotland, during the same period, we encounter in poetry the names of James I., king of Scotland (murdered 1437), author of the *King's Quhair*, etc.; Andrew Wyntoun, prior of Lochleven, whose *Orygynale Cronykil of Scotland* was completed about 1420; Blind Harry, author of *The Adventures of William Wallace*, written about 1460, long exceedingly popular with the Scottish peasantry; Robert Henryson (died abt. 1500), author of *The Testament of Cresseid*, etc. William Dunbar (died abt. 1520), whose *Dance of the Seven Deadly Sins* shows him to have possessed great boldness and vigor in delineation of character; and Gavin Douglas (died 1522), whose best work is a translation of Virgil's *Aeneid* into English verse—at least into what both Scotchmen and Englishmen then reckoned English verse.

3. *The Period extending from the English Reformation to the Present Day.*—Among the brilliant works of the Elizabethan age, there is probably none of which we may not detect germs in some of the efforts in the century that preceded. In theology, the names of Latimer (burned 1555), of Cranmer (burned 1556), and of Ridley (burned 1555), shine forth conspicuously; and it is sufficient to mention Sir Thomas More (beheaded 1535), author of *Utopia*, a curious philosophical work, and Roger Ascham (died 1568), as excellent miscellaneous writers of that time. The last mentioned, indeed, exercised considerable influence on the development of the English tongue, and his *Scholemaster* is even yet influential. We may here mention the Scotchmen, Mair or Major, Sir David Lyndsay, Boece, Melville; and, above all, George Buchanan, universally admitted to have been one of the finest classical scholars that ever appeared in Christendom.

For the origin of the English drama, see DRAMA: MYSTERIES AND MIRACLE PLAYS. It is necessary here only to note that the first English comedy, *Ralph Roister Doister*, was written by Nicholas Udall about 1552-3, and the first English tragedy, *Gorboduc*, or *Ferrex and Porrex*, by Sackville and Norton a few years later. The era on which we are next to look, the Elizabethan, is the most brilliant in the literary history of England. We may quote here the words of Lord Jeffrey: ‘In point of real force and originality of genius, neither the age of Pericles, nor the age of Augustus, nor the times of Leo X. or of Louis XIV., can come at all into comparison. For in that short period we shall find the names of almost all the great men that this nation has ever produced; the names of Shakespeare, and Bacon, and Spenser, and Sidney; of Raleigh, and Hooker,

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and Taylor; of Napier, and Milton, and Cudworth, and Hobbes; and many others—men, all of them not merely of great talents and accomplishments, but of vast compass and reach of understanding, and of minds truly creative; not men who perfected art by the delicacy of their taste or digested knowledge by the justness of their reasonings; but men who made vast and substantial additions to the materials upon which taste and reason must hereafter be employed, and who enlarged to an incredible and unparalleled extent both the stores and the resources of the human faculties.' Even the minor dramatists of the time, such as Marlowe and Chapman, Beaumont and Fletcher, Jonson and Drummond, all are nearly the equals of any succeeding poets that have appeared. In the latter half of this period a new class of poetic writers started up, lyreal rather than dramatic, whose occasional verses, sometimes descriptive, sometimes amatory, sometimes religious, are characterized by a bright and delicate fancy, as if morning sunbeams glittered on their pages. These are George Wither, William Browne, Francis Quarles, and George Herbert, 'the sweet psalmist of the 17th century' (as Emerson calls him). The last 40 years of the 17th c. are generally known as the age of the Restoration and the Revolution. During this period, the literature of the stage was disgraced by its indecency. Charles II. and his dissolute court had brought back with them from France a love of polite profligacy, which found its most fitting expression in the comedy of intrigue. Four names stand out conspicuous as 'sinners above all men in that generation'—Wycherly, Congreve, Vanbrugh, and Farquhar. Yet theology could boast of such names as Baxter, Owen, Calamy, Collier, Leighton, South, Tillotson, and Barrow. This was the epoch also when the great Milton, driven into the shades of obscurity by political adversities, fulfilled the uttered hope of his youth, and wrote 'something which posterity will not willingly let die.' About this time, too, Walton angled, and Butler burlesqued dissent; Marvell turned his keen irony against the High Church; Locke and Newton speculated and discovered; and John Dryden, literary chief of the time, 'found the English language,' according to Dr. Johnson, 'of brick, and left it of marble.'

The literary history of the 18th c., and of the reign of Queen Anne, has been variously estimated. If it was overvalued, says Prof. Spalding, by those who lived in it, and in the age that succeeded, it has assuredly been undervalued in our own day. It was long glorified as the Augustan age of English literature; but among ourselves it has been set aside as a skeptical, utilitarian age, when poetry could find no higher field than didactic discussion, and prose found nothing to amuse but comic and domestic narrative, or bitter and stinging satire. The truth, as usual, lies in the middle. This age was far from being superior to every era that had gone before it, and it was not quite so low as some of its hostile critics have represented. One thing, however, is beyond dispute, viz., that the *form* both in poetry and in prose, had come to be much more regarded

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than the *matter*. Addison, Swift, and Johnson may be taken as types of the prose writers of this century. Defoe, the author of *Robinson Crusoe*, will live forever. The poetry of the time is represented by Pope, and it has been gravely asked whether he is a poet at all. Young and Akenside were animated by a higher poetic sense, and the same may be said of Thomson, Gray, Collins, Beattie, and Cowper. The greatest poet, however, of the 18 c. was Robert Burns. Richardson, Fielding, Smollett, Sterne, Goldsmith, and Mackenzie are the novelists of this period; Hume, Robertson, and Gibbon, its historians; Butler, Berkeley, Clarke, Shaftesbury, Hume, Paley, and Adam Smith, its philosophers.

The 19th c. has been so prolific in every department of literature that pages would be required merely to catalogue the names of well-known authors. It has produced none so supremely alone as Shakespeare, Milton, and Bacon, but it numbers not a few of the eminent among the multitude who may be characterized as noted. The first quarter of this century was made illustrious by the original genius of Wordsworth and Coleridge, Scott and Byron, Shelley and Keats, near to whom, in general estimation, were Campbell, Southey, and Moore; and other poets of the time, such as Hogg, Cunningham, and Rogers, deserve mention. Wolfe, who wrote *The Burial of Sir John Moore*, and Hood, author of *The Bridge of Sighs*, are examples of those who are immortal in one or several exquisite brief poems. The religious poets include Heber, Keble, Milman, Montgomery, Pollok, and Bowring. Others excelled in ballad writing, as Aytoun, Lockhart, and Macaulay; in humorous legends, Barham; in lyrical and other verse, Croly, Dibdin, Dobell, Elliott, Robert Bulwer Lytton, Mackay, Massey, Milnes, Praed, Patmore, Procter, Arnold, and Rosetti. The great poets of the second and third quarters of the century were Tennyson and Browning, the former worthily the laureate, and both supreme in their way. Later have come into repute William Morris, Sir Edwin Arnold, and Swinburne. Among the more distinguished poetesses are Mrs. Norton, Eliza Cook, Mrs. Landon, Mrs. Hemans, Adelaide Procter, Mary Howitt, Jean Ingelow, Mrs. Mulock-Craik, Christina Rosetti, and Mrs. Browning. The dramatists are well represented by Joanna Baillie, Miss Mitford, Knowles, Edward Bulwer Lytton, Milman, Talfourd, and Tom Taylor; and play-writers have been numerous. The 19th c. has abounded in novelists, essayists, reviewers, and journalists. The first half of the period is memorable for the masterly reviews and essays of Jeffrey, Sydney Smith, Wilson, Hazlitt, Lamb, John Foster, De Quincey, Macaulay, and Carlyle, all partaking of a more purely literary spirit than the political, sociological, and scientific contributors who have especially given character to the quarterlies and monthlies of more recent years. Arthur Helps is a bright example of those who have combined the two tendencies. Miss Martineau and Frances Power Cobbe are noted names in periodical literature. In religious discussion and essays

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Whately, Isaac Taylor (senior), James Martineau, F. W. Maurice, J. R. Seeley, and Henry Rogers have been conspicuous; in the tractarian movement, Keble, Pusey, and J. H. Newman; in the Catholic ranks, F. W. Faber, Wiseman, and Manning. While English secular oratory has declined in this century, the pulpit has not been wanting in men of eloquence, as witness Hall, Irving, Chalmers, Robertson, Liddon, Vaughan, Stanley, Farrar, Spurgeon, and others; and in Biblical literature may be named Kitto, Alford, Trench, Conybeare, Howson, Henderson, Westcott, Ellicott, Davidson, and Tregelles. Mental philosophy is represented by Reid, Stewart, Brown, Hamilton, and Bain; the intuitive ethical, by Calderwood; the utilitarian, by Bentham and the two Mills; the evolutionary, by Herbert Spencer; and the history of philosophy, by Morell, Lewes, and in part by Lecky. Maine contributed much to the subject of ancient law; Buckle applied positivism to the history of civilization; and Senior, M'Culloch, the Mills, Fawcett, Price, and Jevons have been noted political economists. In aesthetics, Ruskin is most prominent, and next to him, Leslie, Eastlake, Mrs. Jameson, Hamerton, and others. The novelists of the century are so numerous that only a few whose works continue to be read can be mentioned, such as Scott, Dickens, Bulwer, Thackeray, Brontë, 'George Eliot' (Mrs. Lewes); and twenty or thirty more, ending with Du Maurier, might be named as likely to live in their well-known works, unless crowded out of memory. The list of biographers is long, including Scott, Southey, Moore, Talfourd, Lockhart, Carlyle, Forster, Dixon, Lewes, Stanley, Smiles, Froude, Morley, and others. English history has been ably written by Mackintosh, Turner, Lingard, Knight, Miss Strickland, Hallam, Macaulay, Froude, and Green; Grecian, by Mitford, Gillies, Thirlwall, and Grote; Roman, by Merivale and Arnold; and other historical works or studies of importance are by Alison, Milman, Rawlinson, Gladstone, Freeman, etc. Books of travel and exploration have abounded, especially those relating to central and western Asia, interior Africa, and the arctic regions; and philology and archæology have had distinguished investigators, as in Egyptian, Assyrian, and East Indian fields. Natural and physical science shows an illustrious roll of names, in almost every instance with literary excellence added to scientific achievements; the name of Charles Darwin, whose *Origin of Species* is one of the epoch-making books of the world, stands pre-eminent; but Priestley, Young, Davy, Brewster, Herschel, Faraday, Huxley, and Tyndall have all made their scientific writing contributions to literature of the highest class.

In the United States, R. H. Dana was one of several who followed the new English school of poets in the first quarter of the century; with him were Halleck, best known by one remarkable poem, and Bryant, our prince of meditative and descriptive verse. Poe stands the master of the musical and weird; Emerson and Whitman as more poetic in spirit than in form; Holmes as combining senti-

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ment and satire with polish. The favorite poets of high rank are Longfellow and Whittier. Lowell is one of the most affluent, but more noted for his humorous than his serious verse, his fame as a humorist being shared by Harte, Leland, and Saxe. Nothing more perfect in their way can be found than several of the poems of T. Buchanan Read. The single-song immortals are Key and Payne. Of the long list of true poets it seems invidious to name only a score or more, such as Allston, Drake, Pierpont, Percival, Morris, Willis, Hoffman, Street, Tuckerman, Sargent, Parsons, Holland, Taylor, Boker, Hayne, Hoyt, Lanier, Stedman, Butler, Aldrich, Gilder; and among women, Sigourney, the Carys, Terry, Moulton, Larcom, Helen Hunt Jackson, Lazarus, Thaxter, Spofford, Thomas, etc. Among essayists, the more recent include Whipple, Mitchell, Thoreau, Curtis, Warner, Higginson, Hutton, Burroughs, Fiske, Scudder, Lodge, and many more, Emerson having the greatest celebrity. In the secular oratory of this century, Webster and Clay led the van, and Prentiss, Choate, Everett, Phillips, and Sumner were among the many distinguished; in sacred oratory, every denomination has had its shining examples, H. W. Beecher by common consent the most popular. Biblical and religious literature in the middle or the latter half of the century has conspicuous representatives in E. Robinson, Hackett, Kendrick, Conant, Stowe, Schaff, Abbott, Harper; and in argumentative publications, Bushnell, Park, Parker, the Hodges, Fisher, Shedd, etc. Metaphysics proper has had systematic treatment by Hickok, and exposition by Bowen, Harris, Carus, McCosh, and Bowne; psychology, by these and by Porter, Ladd, James, etc.; ethics, by Mark Hopkins, Schurman, and others, not to mention mere manuals. Kent, Story, Lieber, Wheaton, Woolsey, G. T. Curtis, and Mulford are among the great names in the literature of law and government; Carey, the Walkers, Atkinson, Sumner, and George are examples of the most noted in political economy; and new names are appearing in sociology. Biography has too many notable examples to be named. The most eminent historians are G. Bancroft, Prescott, Motley, Parkman; and the most voluminous, H. H. Bancroft. Travel and exploration, especially in Central America and the Pacific and arctic regions, have had important contributors. Sketch-writing and fiction in the first quarter of the century recall the high names of Irving, Cooper, and Paulding; the acme was reached by Nathaniel Hawthorne; the largest circulation in the last half of the century by the works of Mrs. Stowe and Lew Wallace; and among the multitude of successful novelists, two special schools are to be remarked,—the realistic of Howell and James, and the dialectal, dating back to Judge Haliburton of Nova Scotia, and more lately illustrated by Cable, J. C. Harris, Murfree, Wilkins, and others. Our many noted novelists cannot be here enumerated, nor anything mentioned but a few leading departments of literature, omitting all that is of a scientific character, however literary in its presentation; omitting also the peculiarly

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American school of humor exemplified by Clemens and others.—See Chambers's *Cyclopædia of English Literature* (3d ed. 1876); histories of the same by Marsh, Dulcken, Robertson, Craik, Spalding, Mrs. Oliphant, etc.; Wright's *Biographia Britannica Literaria* (1842–6); Allibone's *Critical Dictionary of English Literature*; Taine's *English Literature* (1871); M. C. Tyler's *History of American Literature* (1878); C. F. Richardson's *American Literature* (1887); Stedman and Hutchinson's *Library of American Literature* (1887–90).

ENGLISH PALE, or IRISH PALE, or THE PALE: strictly the ‘boundary line;’ used to designate the part of Ireland subject to English laws prior to the general English occupation of the country, though the limits varied at different times, the term was commonly applied to what is now the province of Leinster, and Cork, Kerry, Waterford, Tipperary, and Limerick. Dublin, Meath, Carlow, Kilkenny, and Louth were almost always within the E. P.

ENGORGE, v. *ĕn-gōrj'* [en, in; F. *gorger*, to gorge]: to put into the throat or gorge; to swallow with greediness; to swallow in large quantities; to devour; to gulp down. ENGORGING, imp. ENGORGED', pp. *-gōrjd'*. ENGORGE'MENT, n. a swallowing greedily; in *med.*, applied to an overfilled state of the vessels of a part.

ENGOULÉE, a. *āng-gō lū* [F. *engouler*, to swallow]: in *her.*, bends, crosses, saltiers, etc., the extremities of which enter the mouths of animals.

ENGRAFT, v.: see INGRAFT. ENGRAFF, v. *ĕn-grăf'*, in *O.E.*, to graft; to unite. ENGRAFTING: see GRAFTING.

ENGRAIL, v. *ĕn-grāl'* [F. *engréler*—from *gréler*, to hail]: in *her.*, to spot as with hail; to make ragged at the edges. ENGRAILED', pp. a. *-grāld'*, indented along the edges as with hail: N. a line composed of a series of little half-moons, or semicircles. In *heraldry*, grailed is the opposite of inverted. ENGRAIL'MENT, n. the ring of dots round the edge of a medal.

ENGRAIN, v. *ĕn-grān'* [en, and *grain*]: to cover or dye deeply; to dye in the grain. ENGRAIN'ING, imp. ENGRAINED' pp. *-grānd'*, dyed in grain.

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ENGRAVE, v. *ĕn-grāv'* [*en*, and *grave*]: to cut figures or letters on metals, rare stones, pebbles, wood, etc.; to imprint or impress deeply, as on the memory. **ENGRA'VING**, imp.: N. the art of cutting devices, figures, or letters on metals, stones, etc.; the print from an engraved plate. **ENGRAVED'**, pp. *-grāvd'*: ADJ. marked as with a chisel; imprinted; deeply impressed; also **ENGRAVEN**, pp. *ĕn-grāv'n*. **ENGRA'VER**, n. one who; a carver. **ENGRA'VINGS**, n. plu. impressions on paper taken from copper or steel plates—those from wood blocks are usually called *woodcuts*.

ENGRAVE, v. *ĕn-grāv'* [*en*, and *grave*]: in *OE.*, to place in a grave; to bury.

ENGRAV'ING: in its widest sense, art of incising designs, writing, etc., on any hard substance, such as stone, metal, or wood. Many branches of the art are of great antiquity; such as gem-engraving, cameo-cutting, and die-sinking. For the more important of these ornamental and useful kinds of E., see the proper titles. But in a narrower sense, E. is the special designation of the art of cutting or indenting the surface of metal plates or of blocks of wood with designs, for the purpose of taking off impressions or *prints* of the designs on paper. This department of the art arose as late as the 15th c., the earliest wood E. with a date being 1423, and the earliest dated E. from a metal plate being 1461.

Wood E. differs from E. on metal in this, that on a metal plate the traces or marks which are to appear on the paper are cut or sunk into the plate, and when printed from are filled with ink, while the rest of the surface is kept clean; whereas in wood E. they are left prominent or in relief, and the blank parts of the design are cut away. Hence a wood-cut acts as a *type*, and is inked and printed from in the usual way: see **PRINTING**. This makes wood E. peculiarly suitable for illustration of books; as the blocks can be printed from together with the letterpress; while the impressions from a metal plate must be taken by themselves, and by a slow process. See **WOOD-ENGRAVING**.

As to E. on metal, with which this article is concerned, the metals most used are copper and steel, the former having the advantage of being more easily worked, the latter of greater durability. The process of working are essentially the same in both. The several manners or styles of E. are distinguished as Line-engraving, Mezzotinto, Stippling, and Aquatinta.

1. *Line-engraving*—in which, as the name implies, the effect is produced by a combination of lines—is executed either by direct incision with the graver or the dry-point, or by a combination of incision with *etching*—a chemical process below described. The *graver* or *burin* is usually in the form of a quadrangular prism, fitted into a short handle. In making the incision, the graver is pushed forward in the direction of the line required, being held by the handle, at an angle very slightly inclined to the plane of the copper. A *scraper* is required to *scrape* off the barb or burr which is

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formed by the action of the graver and dry-point. The *rubber* is a roll of cloth dipped in oil, and is used to make the surface smooth. A *burnisher* is required to polish the plate, and erase any scratches which it may accidentally receive; also to make lighter any part of the work which may have been made too dark. The *dry-point* is like a sewing-needle fixed into a handle, and is used to cut or scratch the finer lines. The graver cuts the copper clean out; the dry-point throws it up on each side, and in some cases this is not scraped off, but made use of till it is worn off, as it gives richness to the line.

In etching, the first step is to cover the plate with a composition of wax, asphaltum, gum mastic, resin, etc., dissolved by heat; an outline of the design, made on paper in pencil or red chalk, is then ‘transferred’ to the surface of this composition, by being passed through a press. The subject is then drawn on the ground with the etching-point, which cuts through it, and exposes the copper. *Etching-points* or *needles* resemble large sewing-needles shortened, and fixed into handles four or five inches long; some are made oval, to produce broader lines. A rim of wax being put round the plate, acid is poured on, and corrodes the copper not protected by the ground. If the acid is found not to have acted sufficiently, it may be applied again to the whole design, or only to portions of it, by *stopping up*, with a mixture of lampblack and Venice turpentine applied with a camel-hair pencil, what has been sufficiently *bitten in*.

When a series of parallel lines are wanted, as in backgrounds, etc., an ingenious machine called a ruler is employed, the accuracy of whose operation is perfect. This is made to act on etching-ground by a point or diamond connected with the apparatus, and the tracings are bit in with aquafortis in the ordinary way.

2. The process of *mezzotinto* is much less difficult than line-engraving. The plate is prepared by being indented or hacked all over by an instrument with a serrated edge, called a cradle, which is rocked to and fro upon it in all directions. The barb or nap thus produced retains the printer’s ink, and if printed, a uniform dark surface would be the result. On this plate, after a tracing has been transferred, the engraver goes to work with tools called scrapers and burnishers—those parts of the ground most smoothed being the highest lights, and the ground the least operated on producing the deepest shadows. As the work proceeds, it may be blackened with ink, applied with a printer’s ball or otherwise, in order to ascertain the effect. The design is sometimes etched on the plate by the ordinary process, before the mezzotinto ground is laid.

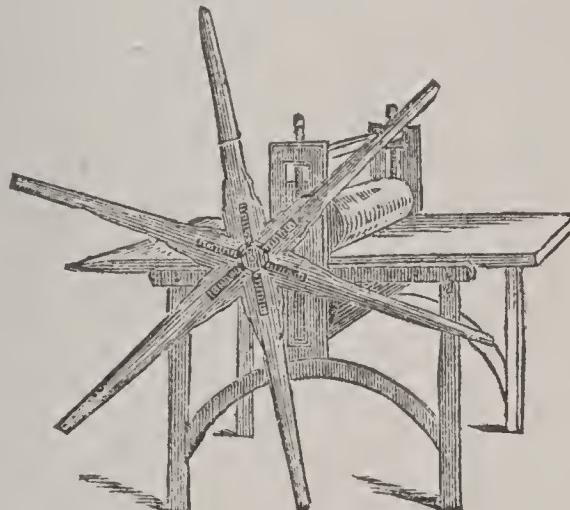
3. *Aquatint Engraving*.—By this method, the effect of drawings in Indian ink is produced; and at one time it was greatly made use of in rendering the drawings of Paul Cudby and early water-color painters, and particularly prints for drawing-books. In this process, a very complex kind of etching, the ground composed of pulverized resin on spirits of wine, assumes when dry a granulated form; and the aquafortis acting on the metal between the particles,

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reduces the surface to a state that an impression from it resembles a tint or wash of color on paper. David Allan engraved his celebrated illustrations of the *Gentle Shepherd* in this manner. It has now gone almost entirely out of use, having, like engraving in imitations of drawings in chalk or pencil, been in a great degree superseded by lithography.

4. In Engraving in *Stipple*, much in vogue in the end of the last c., the drawing and effect are produced by small dots, in place of lines. Ryland, Bartolozzi, and Sherwin, excelled in this style. It is well suited for portraits; several of Raeburn's have been capitally engraved in stipple by Walker. It involves much more labor than mezzotinto, and is now little practiced.

Plate-printing.—Copper-plates, engraved in any of the above styles, are ready for press as soon as they are finished by the engraver. The method of printing from them is very simple. Their engraved surface is daubed over with a thick oleaginous ink, so that the lines are effectually filled. As this dirties the whole of the plate, it is necessary to clean it, which is done by the workman wiping it first with a piece of cloth, and then with the palms of his hands, rubbed on fine whiting. It may be calculated that a hundred times more ink is thus removed than actually remains in the indentations; however, such a process is necessary. The plate being thoroughly cleaned, is laid on a press (see fig.), with a piece of damped paper over it; and



being wound beneath a roller covered with blanket-stuff, it is forced to yield an impression on the paper. The plate must be kept at a moderate warmth during the operation. The frequent rubbing of the plate with the hand to clean it, as may be supposed, tends greatly to wear it down; and such is the wear chiefly from this cause, that few copper plates will yield more than a few thousand impressions in good order. The earliest, called *proofs*, are always the best and most highly prized.

In consequence of this defect in copper, the practice of engraving *steel-plates*, for all subjects requiring a great many impressions, has become very common. This process was introduced by the late Mr. Perkins, of London, who origi-

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nally softened the plates, engraved them, and then rehardened them—a practice now abandoned, as ordinary steel-plates can be worked upon by the burin, dry-point, scraper, and burnisher with perfect facility. Etching on steel-plates is executed much in the same way as in the process on copper. An E. on a steel-plate may be transferred in relief to a softened steel cylinder by pressure; and this cylinder, after being hardened, may again transfer the design by rolling it upon a fresh steel-plate; thus the design may be multiplied at pleasure.

History of Engraving.—This most important invention, by which the productions of art are diffused without limit, is said to have been accidental, and is claimed for Tommaso Finiguerra, who first took impressions on paper about 1440. His employment was executing ornamental E., chiefly on articles used in religious services, such as small portable shrines, or altar-pieces. These were generally of silver, and the designs engraved on them were filled up with a black composition that hardened in a short time. This composition was called in Italian *niello* (from Lat. *nigellus*, dim. of *niger*, black), and the workers in it *niellatori*. It was the practice of Finiguerra, in executing his work, to prove it by rubbing lampblack and oil into, and pressing paper over it; he thus obtained an impression of his work as far as to a particular stage, and was enabled safely to carry it on till it was completed. Finiguerra's title to the invention has been disputed; and in a recent work by J. D. Passavant, *Le Peintre-Graveur* (Leip. 1860), a strong case seems made out for its German origin. Be that as it may, the principal early Italian engravers who followed Finiguerra, were Bacio Baldini (abt. 1436–1515); Sandro Botticelli (1437–1515)—he embellished an edition of Dante's *Inferno*, brought out 1481; Antonio Pollajuoli (1426–98, at Florence); Andrea Mantegna (b. Padua, 1431, d. Mantua, 1505); and Marc Antonio Raymondi (b. Bologna, 1487 or '8. d. 1539), who executed his chief works at Rome. The most celebrated early German engravers were Martin Schoengauer (b. Colmar, 1455, d. 1499); Israel van Mecheln, or Meckenem (b. Meckenem on the Meuse about 1450, d. 1523); Michel Wohlgemuth (d. 1519); Albert Dürer (b. Nürnberg, 1471, d. 1528); and Lucas van Leyden (b. Leyden, 1494, d. 1533). The engravings of all these artists are very valuable, not only from their scarceness, and as illustrating the early history and progress of the art, but as exemplifying many high qualities never surpassed in later times. The most of them were painters, and engraved their own works, except Marc Antonio, who engraved chiefly those of Raphael, by whom he was employed and who occasionally overlooked and directed him. All those engravers, and their immediate followers, executed their works with the graver; but soon afterward engravings came to be generally executed by two processes—etching, and cutting with the graver or the dry-point. The works of these early masters are often remarkable for character and expression, as those, for instance, by Mantegna; and for the correctness and high

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style of the drawing, for which qualities Marc Antonio has never been surpassed; also for finish of the most careful and elaborate kind, carried further by Albert Dürer and Lucas van Leyden than by any other engravers. The styles of these early engravers were cultivated by numerous successors, several of whom followed their masters as closely as they could, while others diverged into something like originality: the chief names are Agostino Veneziano, about 1620; Nicolas Belin da Modena, and Giov. Ghisi, 1630; Luc. Damesz (d. 1533); Giov. Giac. Caraglio, and Marco da Ravenna, about 1640; Giul. Bonasone (b. Bologna, 1498, d. Rome, 1564); Eneus Vicus, George Vens, Henrid Aldegraf, and Jean Sebast. Boehm, about 1550; Adrian, Charles, William, and John Collert, Adam and George Ghisi, Suterniann, Virgilius Solis, Cornelius Cort, Martin Rota, and others, ranging from the middle to the end of the 16th c. Agost. Caracci, celebrated painter, executed many spirited engravings. Saenredam, De Bruyn, Galle, Kellerthaller, Alberiti, De Goudt, C. de Pass, Sadeler, are names of well-known engravers that enter on the 17th c. Henry Goltzius is noted for the number and variety of his works, and his imitations of the styles of the older masters. In the plates of engravers toward the middle of the 17th, and beginning of the 18th c., a large proportion of the work consists of etching, the graver being used chiefly for deepening and clearing up the etching. This arose from this manner of working being well adapted for rendering the style of the painters of that period, whose works were distinguished for freedom of execution or touch, and clearness and transparency. The most noted engravers of this period were the Vischers, 1610–50, who engraved many of Berghem's pictures; Bolswert, 1620; Lucas Vosterman the Elder, 1630; Suyderhoef, about 1640. These engravers rendered many of the works of Rubens in a very spirited manner. Coryn Boel—whose engravings from Teniers are in some respects superior even to Le Bas—Troyen, and Van Kessel, are worthy contemporaries.

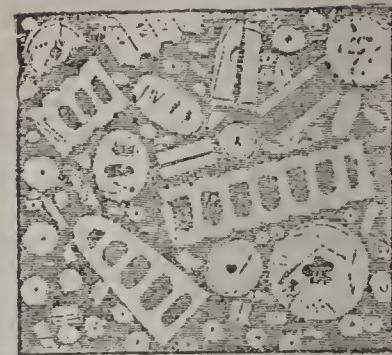
In the age of Louis XIV., a race of engravers of portraits arose, who carried execution with the graver almost to perfection. The works of the artists from whom they engraved were florid in style, with great display of drapery and lace, and accessories in the backgrounds elaborately executed. Among these engravers the following rank highest: Gerard Edelinck (b. Antwerp 1627, d. Paris 1707)—one of the best engravers of the period, and specially patronized by Louis XIV.; Masson (1636–1700); Larmessin (b. 1640–84); Drevet the Elder (1664–1739); Drevet the Younger (b. 1697); Gerard Andran (1640–1703). There was a large family of Andrans engravers, but Gerard was the most celebrated, indeed he was one of the best of the French engravers. Among engravers of talent in England were Robert Walker (b. 1572); William Faithorne (b. London between 1620–30, d. 1694) executed many excellent engravings of portraits; George Vertue (b. London 1684–1756), a good engraver, and a man of general information and taste in art; John Smith (b. London 1654, d. 1722) executed

PLATE 21.

Encarpus
Ensiform



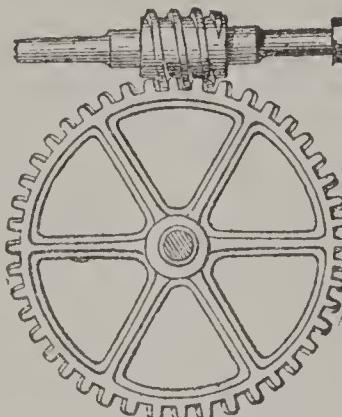
Encarpus.



Piece of Derbyshire Marble, showing
Encrinites.



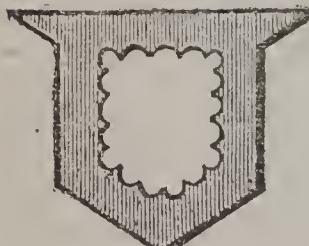
Ensiform Leaf.



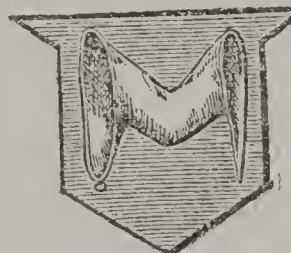
Endless Screw and Wheel



Endorhiz.



Engrailed.



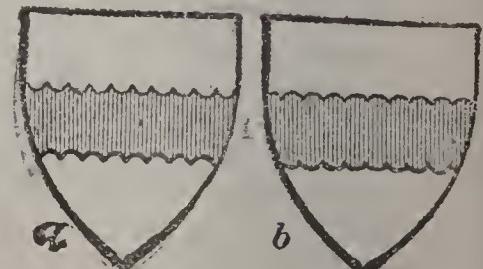
Enmarché.



Engoulée.



Butomus, of the Class **Enneandria**.



a, Fess engrailed; **b**, Fess invecked.

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in mezzotinto a vast number of interesting portraits. In the 18th c. there were numerous excellent engravers, by whose works the taste for the pictures of the Dutch school of the 17th c. has been widely extended. Two of the most distinguished of these were John Philip le Bas (b. Paris 1708, d. 1782) and John George Wille (b. Königsberg 1717, d. 1808). Their styles are totally dissimilar. Le Bas's plates are chiefly etched, and remarkable for spirit and sharpness of touch and transparency; accordingly, mostly all his works are after painters who excelled in these qualities, particularly Teniers. Wille's engravings are of the most careful and elaborate description, and his best prints are after Gerard Dow, Terburg, Mieris, and Metzu—masters distinguished for the high finish of their pictures. He worked with the graver; and his plates are notable for the precision and clearness with which the lines are cut.

It was about the middle and latter portion of last c. that engraving reached its highest point in England. The works of William Hogarth (b. London 1698, d. 1764) are of world-wide celebrity, but that is owing mainly to the excellence and dramatic interest of the pictures from which the engravings are made, though, no doubt, his prints are engraved in a firm clear style, similar to that practiced by the French engravers of the time, several of whom were employed by him. It was Sir Robert Strange (b. Orkney 1721, d. London 1792), engraver of figures, and William Wooley (b. Maidstone 1735, d. London 1785), landscape-engraver, who imparted to English engraving those qualities and characteristics that enable England to claim a style of engraving that is national, differing from other styles, and that has arisen and been best carried out in that country. In drawing and form, Strange was rather defective; but he excelled in what engravers call color, or the art of producing, by means of variety of line, a texture or quality that compensates for the lack of color, by giving to the E. something of the richness produced by color in a picture. His imitation of the softness and semi-transparency of flesh was particularly successful, and superior to that of the French engravers, whose works, though in most respects admirable, failed in that respect, and had, in the more delicate parts, a hard or metallic look. Wooley treated landscape-E. in a manner totally new, imparting more firmness and decision, by making great use of the graver. His works have more finish and force than former landscape-engravers, but they are in some degree liable to the objection of hardness, in the treatment of foliage in particular. The works of these two engravers have had a marked influence on art. The merit of Strange's style was acknowledged on the continent; he was elected a member of the Academies of Florence, Bologna, Parma, and Rome. At the end of last c., art had fallen very low on the continent, but a regeneration was beginning; and in Italy, engravers were then arising, such as Volpato and Cuneo, who studied and imitated the softness and, technically speaking, fleshiness of texture that distinguished the works of the British engraver; those were followed by Raphael

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Morghen, Longhi, Mercurii, and others, in Italy; by Boucher Desnoyers, Forster, etc., in France; and by Müller, Keller, Gruner, and numerous other engravers in Germany. By them, E. has been carried to the highest pitch. Among their works, the following are *chefs-d'œuvre*: *The Last Supper*, after Da Vinci, by R. Morghen; the *Sposalizia*, after Raphael, by Longhi; *La Belle Jardinière*, and other works, after Raphael, by Boucher Desnoyers, who has engraved the works of Raphael perhaps on the whole better than any other engraver; *The Madonna de San Sisto*, by Müller, and *The Dispute on the Sacrament*, after Raphael, of Keller. No engravings executed in England come up to the works of these last-named masters, who have engraved works of a higher class than the majority of those done by Strange, while the drawing and general treatment of their works are in a purer and more correct style. However, the engravings of Burnet, Rimbach, Stewart, and others after Wilkie and contemporary British painters, deservedly hold the highest place among works of the class to which they belong, and betoken clearly the great influence which Strange exercised on their style. At present, few figure-subjects are executed in the line-manner, and that art in England has certainly fallen. This may be accounted for, perhaps, by the great use made of mechanical appliances, in portions of the work, to save time, and by the preference shown for mezzotinto-engraving as practiced at present, that is, with a mixture of lining or stippling. The greater number of Landseer's works have been engraved in that way, and it is now adopted for rendering the works of John Phillip and Millais, and the leading artists of the day. Several, however, of Landseer's earlier works have been engraved in the line manner, particularly his pictures of *Drovers leaving the Grampians*, and *The Watering-place*, by Watt, which are capital examples of line-engraving. There is no good modern school of landscape-E. on the continent; the influence of Wooley was confined to his own country, where landscape-E., particularly in illustrated works after Turner, has attained great excellence.

Toward the end of last c., mezzotinto-E. was practiced in England with great success; arising from its peculiar fitness to render effectively the works of Sir Joshua Reynolds. M'Ardell, Earlom, Watson, Smith, Valentine Green, and Ward were among the best engravers of his works. The invention of this process is generally ascribed to Prince Rupert, some ascribe it to Dr. Wren, 1662, and state that Prince Rupert merely improved on the invention. It has been practiced very generally from the time of its invention, but attained its highest position in Sir Joshua's time; and it is very successfully carried out now, in an altered manner, additional force being aimed at, by means of stippling and etching. It is well calculated for producing broad effects: Turner's *Liber Studiorum*, and the landscapes after Constable, are admirable examples of its capabilities in this way; the effect in Turner's plates, however, is heightened by etching.

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Etching, already described as a part of the process of engraving, as practiced by painters, is classed as a distinct art. The plate is prepared with a ground, and corroded in the same way; but the treatment is more free. Not being tied to the task of literally copying or translating the idea of another, like the engraver, the painter has scope to impart a spirit to his work peculiarly suggestive of what he intends to embody; his idea is represented directly, and not at second-hand. The etchings of Rembrandt, Paul Potter, Karl du Jardin, Adrian Vandervelde, Teniers, Ostade, Berghem, Backhuysen, Van Dyck, Claude, Salvator Rosa, Canaletti, and other painters, are very highly valued, as conveying more completely the feeling of the painter than the best engravings. Etching was more practiced by the old than by modern painters; yet Wilkie, Landseer, and other modern artists, have etched various plates, remarkable for character and spirit.

English Works on Engraving—*Sculpture, or the History and Art of Chalcography and Engraving on Copper*, by John Evelyn (Lond. 12mo 1663; 8vo 1755); *The Art of Engraving and Etching, with the Way of Printing Copper-plates*, by M. Faithorne (Lond. 1702); *Sculptura Historico-technico, or the History and Art of Engraving, extracted from Baldinucci Florent, Le Compt, Fuithorne, and other authors* (4to 1747-70); *An Essay upon Prints*, by Gilpin (Lond. 1767-81); Strutt's *Biographical Dictionary of Engravers* (1785); Landseer's *Lectures on Engraving* (1806); *The Origin and Early History of Engraving*, by William Young Ottley (1816); *Histoire de la Gravure*, by George Duplessis (1880); *The Graphic Arts*, by P. J. Hamerton (1882)—a very comprehensive and excellent work.

In the United States various processes have crowded out wood-E. for general purposes as wood-E. some years ago crowded out steel-E. The comparatively small amount of wood-engraving now done for books and periodicals, is for specially important subjects, drawn by artists of the highest repute and cut by the most experienced engravers. There is more co-operation between artists and engravers than formerly; the engraver has become more of an artist, and his work, with that of the draughtsman, has attained a much higher rank as the embodiment of a distinct art. Steel-E. is now confined mostly to bank-note and stock-certificate work. Etching has greatly grown in popularity and is much in demand for frontispieces. It has almost entirely taken the place of steel-E. excepting as above and for portrait work in expensive publications, and is used chiefly for works of art for framing and the portfolio. The *photogravure* process is largely used for art works, mainly copies of paintings; the *Rockwood* and *Albertype* processes reproduce photographic effects in ink; and the *Ives* process, most popular of all, used in book, magazine, and carefully-printed illustrated-paper work, produces the effects of wash drawing and photographs. The photo-E., photo-lithographic, photo-electrotype, heliotype, and countless other zinc, chalk, and gelatine processes, reproduce line work for relief printing, from pen and ink drawings.

ENGRAVINGS—ENGROSS.

Of late years, many inventions have been introduced, having for their object to supersede by machinery and other appliances the slow and laborious manual operations of engraving: see MACHINE-ENGRAVING: MEDALS: GLASS: ETC. It is, however, to business and ornamental purposes chiefly that these appliances are applicable, and not to the production of artistic work of the kind treated of in this article. With regard to the reproduction of plates, and other applications of galvanic electricity to engraving, see GALVANISM: MAGNETO-ELECTRICITY: also PHOTOGRAPHIC ENGRAVING.

ENGRAVINGS, PROPERTY OF: right of ownership in engravings and prints, secured by statutes both in the United States and Great Britain, similar to those for the protection of literary property: see COPYRIGHT.

ENGROSS, v. *ĕn-grōs'* [F. *grossoyer*, to write in great and fair letters—from *gros*, big, large: F. *grosse*; Dut. *gros*, a notarial copy]: to copy in a fair large hand—generally said of legal documents. ENGROS'SER, n. one who engrosses. ENGROS'SING, imp.: N. the copying of a writing in fair and legible characters; in *Scotland*, the corresponding term is ‘extending a deed.’ ENGROSSED’, pp. *-grōst'*. ENGROSS'MENT, n. the copy in a large fair hand.

ENGROSS, v. *ĕn-grōs'* [F. *engrossir*, to make great, to increase, to enlarge—from F. *gros*, great—the primary signification being to buy up a commodity in order to increase the price]: to make great, thick, bulky, or coarse; to occupy the whole, as the thoughts; to take or assume in undue quantities or degrees. ENGROS'SING, imp.: N. the invidious occupation of anything which ought to be shared with others. ENGROSSED’, pp. *-grōst'*. ENGROS'SER, n. one who. ENGROSS'MENT, n. the act of appropriating things in undue quantities.—SYN. of ‘engross’: to absorb; engulf; occupy; swallow up; forestall; monopolize.—ENGROSSING AND REGRATING (known also as Forestalling), an offence against old English laws now abrogated; the act of one who buys grain, flesh, fish, or other articles of food, with the intention of selling them again at an enhanced price, either in the same fair or market, or in another in the neighborhood, or who purchases or contracts for corn while still in the field. These practices were regarded as criminal in most countries, before the laws by which trade is regulated were properly understood. In England, they were forbidden by various statutes, from the time of Edward VI. to that of Queen Anne. These statutes were repealed by 12 Geo. III. c. 71, on the preamble, that it hath been found by experience, that the restraints laid upon the dealing in corn, meal, flour, cattle, and sundry other sorts of victuals, by preventing a free trade in the said commodities, have a tendency to discourage the growth, and to enhance the price of the same. It was found, however, that engrossing was not only a statutory but a common law offense, and a prosecution for it in the latter character actually took place in the present century. The Act 7 and 8 Vict. c. 24, for

ENGUARD—ENHARMONIC.

abolishing the offenses of forestalling, regrating, and engrossing, was consequently passed. These offenses have not been known to the law in the United States. This English statute also repeals a whole host of earlier enactments in restraint of trade, which had been omitted in the statute in the time of George III., above referred to. The rubrics of these enactments give a curious picture not only of the trading errors, but in many other respects of the obsolete customs of our ancestors. The first, for example (51 Henry III.), is called a ‘Statute of the Pillory and Tumbrel, and of the Assize of Bread and Ale.’ Then there is an act passed in several reigns which provides for the punishment of ‘a butcher or cook that buyeth flesh of Jews, and selleth the same to Christians.’—See MONOPOLY. The statute 6 and 7 Vict. c. 24 does not apply to the spreading of false rumors, with the intent to enhance or decry the price of merchandise, or preventing goods from being brought to market by force or threats, which continue to be punishable as if that act had not been made.

ENGUARD, v. *ěn-gárd'* [*en*, and *guard*]: in *OE.*, to surround as with guards; to protect; to defcnd.

ENGUERA, *ěn-gwā'rā*: town of Spain, province of Valencia, 43 m. s.w. of the town of Valencia. It is poorly built, and has narrow and irregular streets. It has manufactures of linen and woolen goods, and some trade in cattle and agricultural produce. Pop. (1877) 6,358.

ENGUICHÉ, *āng-gē-shā*: term in heraldry. A hunting-horn, the rim around the mouth of which is of different color from the horn itself, is said to be enguiché, of the color in question.

ENGULF, v. *ěn-gǔlf'*, or **INGULF'** [*en*, and *gulf*]: to swallow up; to absorb; to throw into a gulf. **ENGULF'ING**, imp. **ENGULFED'**, pp. *-gǔlft'*.

ENHANCE, v. *ěn-hāns'* [Prov. *anz*, before; *enans*, forward; *enansar*, to put forward, to exalt—from L. *ante*, before: comp. Norm. F. *enhausser*, to exalt]: to raise, as in value or esteem; to advance; to increase; to aggravate. **ENHAN'CING**, imp. **ENHANCED'**, pp. *-hānst'*. **ENHAN'KER**, n. *-sér*, one who. **ENHANCE'MENT**, n. increase; aggravation.

ENHARMONIC, a. *ěn'hár-món'ík* [Gr. *enarmónikós*, conformed to the rules of harmony—from *en*, in; *harmónia*, harmony of sound]: applied to a scale of music proceeding by very small intervals. It is the scale in which the name of a note is changed without any sensible difference of sound, such as C♯ and D♭, F♯ and G♭. Correctly speaking, there is, or should be, a difference; but on keyed instruments, such as the organ and pianoforte, there can be none, as the same key serves for both sharp and flat, while with a just equal temperament the ear is in no way offended. In harmony, the principal seat of enharmonic change is in the chord of the diminished seventh, which, by a change of the notes, may be treated fundamentally in

ENHYDRIS—ENLARGE.

four different ways, without any sensible difference in the intonation.

ENHYDRIS, n. *ěn-hī'drīs* [Gr. *en*, in; *hudōr*, water]: in zool., sea-otter; genus of carnivorous mammals, family *Mustelidæ*; found in the regions bordering the n. Pacific on either side, and is killed for its valuable fur, which is thick and woolly.

ENHYDROUS, a. *ěn'hī-drūs* [Gr. *en*, in; *hudōr*, water]: applied to crystals and minerals containing water—the opposite of *anhydrous*.

ENIF, n. *ěn'īf*: the fixed star ε Pegasi.

ENIGMA, n. *ě-nīg'mā* [Gr. *ainigma*; L. *ænigma*, obscure speech; F. *énigme*]: a riddle; a dark saying; anything obscure or ambiguous. **EN'IGMAT'IC**, a. *-māt'ik*, or **EN'IGMAT'ICAL**, a. *-i-kāl*, darkly expressed; obscure. **EN'IGMAT'ICALLY**, ad. *-lī*. **ENIG'MATIST**, n. *-mā-tīst*, a dealer in enigmas, one who makes enigmas. **ENIG'MATIZE**, v. *-tīz*, to utter or form riddles. **ENIG'MATIZING**, imp. **ENIG'MATIZED**, pp. *-tīzd*.

ENJOIN, v. *ěn-joyn'* [F. *enjoindre*—from L. *injungēre*, to join or fasten into—from *in*, into; *jungo*, I fasten; It. *ingiugnere*]: to command; to order; to bid; to urge. **ENJOIN'ING**, imp. **ENJOINED**, pp. *ěn-joyn'd*. **ENJOIN'ER**, n. one who.

ENJOY, v. *ěn-joy'* [en, and F. *jouir*, to enjoy—from L. *gaudēō*, I enjoy]: to feel or perceive with pleasure; to take pleasure in the possession of; to possess and use, as an estate. **ENJOY'ING**, imp. **ENJOYED**', pp. *-joyd'*. **ENJOY'MENT**, n. pleasure; satisfaction; possession; possession with pleasure. **ENJOY'ABLE**, a. *-ă-bl*, that can be possessed with pleasure. **TO ENJOY ONE'S SELF**, to have pleasure and great satisfaction in.—**SYN.** of ‘enjoyment’: gratification; fruition; happiness.

ENKHUIZEN, *ěnk-hoy'sēn*: fortified town and seaport of the Netherlands, province of N. Holland; on the western shore of the Zuider Zee, about 30 m. n.e. of Amsterdam. It is built with great regularity, and is of circular form. The most important public building is an elegant town-house, with a lofty tower. There are two Dutch Reformed Churches, to which five-sixths of the people belong, the rest being Lutherans, Rom. Catholics, Moravians, and Jews. The chief industries are ship and boat-building, rope-spinning, sail-making, refining salt, brewing, etc. There is a small trade in butter, cheese, corn, timber, cattle, and fish. Several vessels are engaged in the herring-fishing. Pop. (1890) 6,328.

ENKINDLE, v. *ěn-kin'dl* [en, and *kindle*]: to inflame; to excite; to rouse into action. **ENKIN'DLING**, imp. **ENKIN'DLED**, pp. *-dld*.

ENLARGE, v. *ěn-lārj'* [en, and *large*]: to make larger or greater; to increase in magnitude; to extend; to expand; to amplify; to expatiate; to augment; to set free. **ENLAR'GING**, imp. **ENLARGED**', pp. *-lārjd'*: ADJ. having liberal

ENLIGHTEN—ENLIST.

and comprehensive views. ENLARGE'MENT, n. increase of size; expansion; release from confinement. ENLAR'GER, n. -jér, one who.—SYN. of 'enlarge': to dilate; distend; increase.

ENLIGHTEN, v. ēn lit'n [Ger. *erleuchten*, to illuminate —from *leuchten*, to lighten]: to shed light on; to illuminate; to instruct. ENLIGHT'ENING, imp. -lit'ning. ENLIGHT'ENED, pp. -lit'nd: ADJ. supplied with light; intelligent. ENLIGHT'ENER, n. -lit'ner, one who. ENLIGHT'ENMENT, n. -lit'n-mēnt, state of being enlightened or instructed.

ENLINK, v. ēn-līngk' [en, link]: in *OE.*, to combine in links; to connect. ENLINKED, or ENLINKT, pp. ēn-līnk't, connected; chained together.

ENLIST, v. ēn-līst' [en, on; F. *liste*, a roll: It. and Sp. *lista*, a strip of paper (see LIST)]: to register; to enrol; to engage in the public service, as in the army; to enter heartily into a cause. ENLIST'ING, imp.: N. the act of engaging men to enter into military service; the act of engaging one's self in a cause. ENLIST'ED, pp. ENLIST'MENT, n. the act of engaging, as a soldier or sailor, or of attaching one's self to a cause; voluntary enrolment. It is the mode by which the army and navy in the United States and in England are supplied with men, as distinguished from the CONSCRIPTION prevailing in many other countries. In the British army, since 1870, men are allowed to enlist for 12 years, with the understanding that 6 years or less shall be passed with the colors, and the remainder with the reserve. This is known as 'short service;' and, under the system, from 1876 onward, a reserve of trained soldiers has been formed. It is estimated that with an army of 180,000 men, of whom three-fourths are to serve only six years with the colors, there will accrue at the end of six years a reserve of 100,000 trained men, all under 32 years of age. In the U. S. army there is a bureau of general recruiting service, consisting of a supt. and assistants detailed from the line of the army. It has headquarters in New York, and rendezvous in all principal cities. Recruits thus enlisted are sent to one of three recruiting depots (David's Island, N. Y., Columbus barracks, Ohio, or Jefferson Barracks, Mo.—the latter for cavalry only) for preliminary instruction. Recruits may enlist for a particular branch of the service; otherwise they are assigned. An officer at each milit. post is detailed as departmental recruiting officer, to enlist men for that post. Each regt. sends out an officer, called the regimental recruiting officer, to recruit for that regt. in its immediate vicinity. Recruits enlisted by departmental and regimental recruiting officers receive instruction at their respective posts. All recruiting is under charge of the adj.gen. of the army.

In the *British navy*, enlistment is managed by the Admiralty, and is changed from time to time in its details, according to the degree of willingness among seafaring men to enter the service. A seaman may enlist for five or for ten years, or for the period through which the ship that he enters is in commission; if for the longer period, he receives

ENLIVEN—ENNEMOSER.

higher pay and other advantages. At the end of this longer period, he may demand his discharge; and, if abroad, may claim to be brought home free of expense. His commanding-officer may, in emergency, retain his further service for six months, on payment of another increase of pay. The crown, besides, possesses a power of compelling renewed service from seamen under certain conditions, in case of invasion or other national peril. See **BOUNTY**: **COAST VOLUNTEERS**: **IMPRESSIONMENT**: **MANNING THE NAVY**.

In the U. S. Navy, excepting the force of miscellaneous workmen at the navy yards, enlisted men are needed only when a vessel is going into commission. They ship only for that particular cruise or service, and at its expiration are discharged. Should they leave one vessel at a yard or station whence another is about departing they may re-enlist at once. Enlisted men have preferences among vessels and superior officers; and officers, in turn, are glad to re-engage good men who have served under them before. Schoolships are provided for boys, a training station for apprentices, and a war college for young officers, the two latter being on Coaster's Harbor Island.

ENLIVEN, v. *ĕn-liv'ĕn* [*en*, to make, and *live*]: to excite; to make vigorous or active; to cheer or gladden. **ENLIV'ENING**, imp. *-liv'ĕning*: ADJ. invigorating; making sprightly or cheerful. **ENLIV'ENED**, pp. *-liv'ĕnd*. **ENLIV'ENER**, n. *-liv'ĕnĕr*, one who.—SYN. of ‘enliven’: to animate; exhilarate; cheer; inspirit; inspire; invigorate.

ENMANCHÉ, or **EMANCHÉ**: see **MANCHE**.

ENMESH, v. *ĕn-mĕsh'* [AS. *en*, in, and *mesh*, which see]: to entrap or entangle, as with the meshes of a net.

ENMEW, v. *ĕn-mū'* [*en*, *mew*]: in *OE.*, to mew or coop up.

ENMITY, n. *ĕn'mī-tī* [from *enemy*: F. *inimitié*—from L. *inimicitia*, enmity: It. *inimicizia*]: ill-will; unfriendly disposition; hostility.—SYN.: aversion; hatred; antipathy; repugnance; ill-will; malice; rancor; malevolence; animosity.

ENNEACANTOHEDRON, n. *ĕn-nĕ-a-kōn-to-hē'drōn*: solid figure having 90 sides.

ENNEAGON, n. *ĕn'nĕ-ă-gōn* [Gr. *ennēā*, nine; *gōniā*, an angle]: a plane figure with nine sides and nine angles. **ENNEAG'ONAL**, *-al*, relating to an enneagon; having nine angles. **ENNEAG'YNOUS**, a. *-ăj'ĕn-ūs* [Gr. *gunē*, a woman]: in bot., having nine pistils. **EN'NEAT'IC**, a. *-ăt'ik*, ninth; also **EN'NEAT'ICAL**, a. *-i-kăl*. **EN'NEAN'DRIAN**, a. *-ăn'drī-ăn*, or **EN'NEAN'DROUS**, a. *-drūs* [Gr. *andră*, a male]: in bot., having nine stamens. In the Linnæan system, the ninth class of plants (having nine stamens) were called *Enneandria*; but this classification has been superseded. **ENNEATIC-DAY**, *-ăt'ik*, every ninth day of a disease. **ENNEATICAL-YEAR**, *-ăl*, every ninth year of a person's life.

ENNEMOSER, *ĕn'nĕ-mo-zĕr*, JOSEPH: 1787, Nov. 15-1854; b. Hintersee, in the Tyrol: medico-philosophic writer.

ENNIS—ENNIUS.

He commenced his academic studies at Innsbruck 1806; fought in the rising of the Tyrolese against the French 1809; afterward went to Erlangen and then to Vienna, for study. When Napoleon declared war against Russia in 1812, E. was dispatched to England, to solicit aid for the Tyrolese in their meditated insurrection against French domination. He was afterward officer in a Prussian regiment of volunteers, and gathered about him a company of Tyrolese marksmen, who did good service, 1813 and '14. After the peace of Paris, E. went to Berlin, where he finished his studies and, 1816, took his degree doctor of medicine. In 1819, he was made prof. of medicine at the new university of Bonn, where he lectured on Anthropology, Physical Therapeutics, and Pathology. In 1841 he went to Munich, where he obtained great reputation by the application of magnetism as a curative power. Among his many writings his principal work is *Der Magnetismus in seiner geschichtlichen Entwicklung* (Leip. 1819).

ENNIS, ēn'is: municipal borough of county Clare, Ireland, on the Fergus, 20 m. w.n.w. of Limerick. It is a neat town, with some good houses. It has the ruins of a monastery founded 1240 by O'Brien, Prince of Thomond. Near the town is Ennis College, founded by Erasmus Smith. E. has a valuable limestone quarry, large flour-mills, and some trade in grain and cattle. Pop. (1870) 6,503, of whom 6,102 Rom. Cath.; (1881) 6,307; (1891) 5,460.

ENNISCORTHY, ēn'-is-kawr'thī: market-town in the middle of Wexford county, Ireland, on a rising ground on the Slaney, 14 m. n.n.w. of Wexford. The Slaney is here tidal and navigable for barges, and flows through a fertile and beautiful valley. E. has a large grain-trade. The town arose from a Norman castle, still entire, founded by Raymond le Gros, one of the early Anglo-Norman invaders. Cromwell took E. 1649; and the Irish rebels stormed and burned it 1798. Pop. (1871) 5,594; (1881) 5,666; (1891) 5,648.

ENNISKILLEN, ēn'-is-kil'lēn: municipal borough of county Fermanagh, Ireland, about 75 m. w.s.w. of Belfast; chief town of the county. It is beautifully situated on the Erne; the greater portion on an isle in the river between the Upper and Lower Loughs Erne. It consists mainly of one undulating street running e. and w. Around, are richly cultivated eminences and many fine mansions. Its two forts command the only pass for 50 m. into Ulster across the Erne. The chief manufactures are cutlery and straw-plait. E. is famous for the victory, 1689, of the troops of William III., under Lord Hamilton, over a superior force of James II., under Lord Galmoy. The banners taken in the battle of the Boyne hang in the town-hall. The regt. of Enniskilleners, or 6th Dragoons, was instituted from the brave defenders of the town. Pop. (1871) 5,836, of whom 3,242 Rom. Cath., 2,096 Episc.; (1881) 5,836; (1891) 5,570.

ENNIUS, ēn'ni-ūs, Q.: one of the earliest Roman poets, father of the Roman Epos: b.c. 239—b.c. 169; b. Rudiae, in Calabria; probably of Greek extraction. He is said to have

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served in the wars, and to have risen to the rank of a centurion. In Sardinia, he became acquainted with Cato the Elder, and returned with him to Rome when about the age of 38. Here he gained the friendship of the most eminent men, among others that of Scipio Africanus the Elder, and attained (what was then exceedingly rare in the case of an alien) rank of a Roman citizen. He supported himself in a decent but humble manner by instructing some young Romans of distinguished families in the Greek language and literature, his accurate knowledge of which explains the influence that he had on the development of the Latin tongue. His remains were interred in the tomb of the Scipios, and his bust was placed among those of that great family. E. has tried his powers in almost every species of poetry, and though his language and versification are rough and unpolished, these defects are fully compensated by the energy of his expressions, and the fire of his poetry. His poems were highly esteemed by Cicero, Horace, and Virgil; the last, indeed, frequently introduces whole lines from the poetry of E. into his own compositions. His memory seems to have been lovingly cherished by his countrymen; *Noster Ennius*, ‘Our Ennius,’ they used to call him. Of his tragedies, comedies, satires, and particularly of his *Annales*, an epos in 18 books, only fragments are extant. What adds to our regret is, that it is believed his whole works were extant as late as the 13th c. The fragments have been collected and edited by various scholars, among others by Vahlen (1854). The few fragments of his dramas that have come down to us were collected by Ribbeck in his *Scenicæ Romanorum Poesis Fragmenta* (1873). See also the relevant portions of Ribbeck’s *Römische Tragödie* (1875); of Sellar’s *Roman Poets of the Republic*; and of Simcox’s *History of Latin Literature* (1882).

ENNOBLE, v. *ĕn-nō'bl* [*en*, and *noble*: OF. *ennoblir*, to ennoble]: to elevate; to raise to nobility; to exalt; to dignify. **ENNOBLING**, imp. *-blīng*. **ENNOBLED**, pp. *-nō'-blēd*. **ENNOBLEMENT**, n. *-bl-mēnt*, the act of raising to the rank of nobility.

ENNS, *ens*: river of Austria, rising at the n. base of a branch of the Noric Alps in the crown-land of Salzburg, 12 m. s. of Radstadt. It flows first n. to Radstadt, then n.n.e. to Hieflau, after which it proceeds in a general direction n.n.w., passes Steyer, and joins the Danube near the town of Enns, 11 m. below the town of Linz, after a course of about 120 m. Its chief affluents are the Salza and the Steyer. For the last 15 m. of its course, the E. forms the boundary between Upper Austria (*Ober der Enns*) and Lower Austria (*Unter der Enns*). The scenery on the banks of the E. is in general bold and romantic, as it flows, for the most part, between parallel mountain-chains, lofty and precipitous. In its lower course, it becomes navigable, but is important chiefly from the valuable water-power which it supplies.

ENNUI, n. *ĕng-nwē'* [F. *ennui*, weariness—from Sp. *enojo*—from mid. L. *inōdīō*, weariness: comp. Gael. *ain-uidh*, a

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listless state of mind]: heaviness; lassitude; languor or weariness from want of employment.

ENNUYE: see ENNUI.

ENOCH, ē'nok: son of Jared, and father of Methuselah. A peculiarly mysterious interest attaches to him on account of the supernatural manner in which his earthly career terminated. We are told by the writer of Genesis, that E. 'walked with God 300 years . . . and he was not; for God took him.' What the statement 'he was not' signified to the later Jews, is explained by the writer of the Epistle to the Hebrews: 'Enoch was translated that he should not see death.' E. and Elijah are the only human beings on record who were not required to discharge the debt which mortals owe to nature. It may naturally be supposed that E. was a character on whom the extravagant fancy of the later Jews would fasten with unusual pleasure. As they came more and more into contact with Grecian and other culture, they felt the necessity of linking on the arts and sciences of Gentile nations to their own history, if they would continue to preserve that feeling of supremacy which was so dear to their pride as the chosen people. Hence, in later traditions, E. appears as the inventor of writing, arithmetic, astronomy, etc., and is affirmed to have filled 300 books with the revelations which he received, the number 300 being obviously suggested by the number of years during which he is said to have walked with God.

Another Enoch in Scripture, was the eldest son of Cain; he built a city or hamlet which was called by his name.

ENOCH, Book of: ancient apocalyptic work, of date not precisely known, but probably of about the middle of the 2d. c. B.C.; written originally it is probable, in Aramaic, by a native of Palestine. At subsequent periods, it seems to have been enlarged by additions and interpolations. It is divided into five parts: the *first* discourses of such subjects as the fall of the angels, and the journey of E. through the earth and through Paradise in the company of an angel, by whom he is initiated into the secrets of nature, etc.; the *second* contains E.'s account of what was revealed to him concerning the heavenly or spiritual region; the *third* treats of astronomy and the phenomena of the seasons; the *fourth* represents E. beholding, in prophetic vision, the course of Divine Providence till the coming of the Messiah; and the *last* consists of exhortations based on what has preceded. The book—which illustrates the traditions which had grown up around the name of the mysterious Enoch of Genesis—was current in the primitive church, and was quoted by the Fathers, as it had been quoted by the apostle Jude, as any book might be quoted for a single fact without at all authenticating the book as a whole. It never approached a place among canonical books, and was lost sight of by Christian writers about the close of the 8th c., so that until last c. it was known only by extracts. Fortunately, however, the traveller Bruce discovered in Abyssinia three complete

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MSS. of the work, which he brought to England 1773. These MSS. proved to be an Ethiopic version made from the Greek one, in use among the Fathers, as was evident from the coincidence of language. The Ethiopic version did not appear till 1838, when it was published by Abp. Lawrence. An English translation, however, by the same writer, had appeared 1821, which passed through three editions, and formed the basis of the German edition of Hoffmann (Jena 1833–38). In 1840, Gfrörer published a Latin translation of the work; but by far the best edition is that of Dr. A. Dillmann, who, 1851, published the Ethiopic text from five MSS.; and in 1853, a German translation, with an introduction and commentary. An English translation, with notes, was published 1882 by Professor Schodde, of Ohio.

ENODE, a. *ĕ-nōd'* [L. *ex*, out of; *nōdūs*, a knot]: in *bot.*, without knots or joints.

ENOPLA, n. *ĕn'o-pla* [Gr. *enoplos*, in arms, armed: so named from the armature of the mouth or pharynx]: in *zool.*, a tribe of annuloida, order *Turbellaria*, having the mouth or pharynx armed with styles, hooks, or rods. They consist of minute animals, inhabiting fresh or salt water.

ENORMOUS, a. *ĕ-nōr'mūs* [L. *enormis*, irregular—from *ex*, out of; *norma*, a rule: F. *énorme*]: great beyond ordinary measure; excessive; vast; huge; heinous. **ENORMOUSLY**, ad. *-lī*. **ENORMOUSNESS**, n. immeasurable excess; hugeness. **ENORMITY**, n. *-mī-tī*, anything very vicious or sinful; an atrocious crime; any villainy or crime which exceeds the common measure.—**SYN.** of ‘enormous’: prodigious; immoderate; immense; inordinate; outrageous; atrocious; detestable.

ENORTHOTROPE, n. *ĕn-awr'tho-trōp* [Gr. *en*, in; *orthos*, straight; *trepō*, I turn]: toy which depends for its action upon the persistence of visual impressions. Upon different parts of a card are detached parts of a given figure, and when the card is rotated these become assembled and give a combined impression to the eye.

ENOS, *ĕ'nos* (anciently, *Ænos*): ancient town and seaport of European Turkey, province of Adrianople, on a rocky isthmus at the mouth of the Gulf of Enos, abt. 35 m. w.n.w. of Galipoli. It is the port of Adrianople, and has some trade in wool, camels’ hair, cotton, leather, silk, etc. Its harbor is commodious, but so shallow, from being choked with sand, that it admits only small vessels. Pop. 8,000, principally Greeks.—The Gulf of Enos is about $2\frac{1}{2}$ m. wide at the entrance, extends inland about 14 m., and is on an average 5 m. broad.. The town of E. is very ancient. Virgil mentions it (*Æn.* iii. 18) as being one of the towns founded by Æneas, after the sack of Troy; and Homer attests its antiquity by alluding to it in his great poem (*Il.* iv. 519).

ENOSTOSIS, n. *ĕn'ōs-tō'sīs* [Gr. *en*, in; *ostēon*, a bone]: a bony tumor growing inward into the medullary canal of a bone: see **Exostosis**.

ENOUGH—ENRIQUEZ.

ENOUGH, a. *ē-nūf'* [AS. *genoh*, sufficient: Goth. *ganauhan*, to suffice; *ganohs*, enough: Icel. *gnogr*, abundant: Ger. *genug*; Dut. *genoeg*, enough]: that gives content; that satisfies desire; sufficient: N. a sufficiency; a quantity which satisfies desire: AD. sufficiently; fully; sometimes it denotes a slight increase or augmentation, as, he is *ready enough* to oblige; sometimes it expresses indifference or slight, as, the music is *well enough*, that is, not so good as it ought to be; used as an exclamation, to denote fulness or satiety, as, *enough!* ENOW, n. *ē-now'*, sometimes used for enough with a plural meaning.

EN PASSANT, *āng' pás-sáng'* [F. *en*, in; *passant*, passing]: cursorily; by the way.

ENQUIRE, v. *ēn-kwīr'*: see INQUIRE.

ENRAGE, v. *ēn-rāj'* [*en*, in, and *rage*: F. *enrager*]: to provoke; to excite to anger; to exasperate; to make furious. ENRA'GING, imp. ENRAGED', pp. *-rājd'*.—SYN. of 'enrage': to inflame; incite; anger; irritate; incense.

ENRANGE, v. *ēn-rānj'* [*en*, and *range*]: in *OE.*, to place in regular order. ENRANGED', pp. *-rānjd'*, put in regular order. ENRANG'ING, imp., or ENRAUNGING, imp. *ēn rawnj'ing*, in *OE.*, roving over.

ENRANK, v. *ēn-rāngk'* [*en*, rank]: in *OE.*, to place in regular ranks.

ENRAPT, a. *ēn-rāpt'* [*en*, in, and *rapt*]: ravished; thrown into an ecstasy; carried away with emotion. ENRAP'TURE, v. *-tūr* [*en*, *rapture*]: to transport with pleasure or delight. ENRAP'TURING, imp. ENRAP'TURED, pp. *-tūrd*, transported with delight.

ENRAVISH, v. *ēn-rāv'ish* [*en*, *ravish*]: to transport with delight; to fill with the highest degree of pleasure; to enrapture. ENRAV'ISHING, imp. ENRAV'ISHED, pp. *-isht*, carried away with pleasure or delight.

ENRICH, v. *ēn-rīch'* [F. *enrichir*: *en*, and *rich*]: to make rich; to supply or furnish with wealth or property; to fertilize, as land; to supply with anything desirable; to store, as the mind; to adorn, as with carving, painting, etc. ENRICH'ING, imp. ENRICHED', pp. *-richt'*. ENRICH'ER, n. one who. ENRICH'MENT, n. that which enriches; augmentation of wealth.

ENRIDGE, v. *ēn-rij'* [*en*, ridge]: in *OE.*, to form with ridges or long elevations. ENRIDGED', pp. *-rijd'*, raised in long strips or elevations.

ENRING, v. *ēn-rīng'* [*en*, ring]: in *OE.*, to encircle: to bind round.

ENRIQUEZ, *ēn-rē'kēth*, GOMEZ ANTONIO (properly, ENRIQUEZ DE PAZ): Spanish poet; b. Segovia, early in the 17th c.; date of death unknown.; son of a baptized Portuguese Jew. He entered the army in his 20th year, and rose to the rank of captain; but 1636, had to flee the country, to escape the persecution of the Inquisition, which suspected him of a secret leaning to the creed of his father. E. settled at Amsterdam, and latterly professed the Jewish faith;

ENRIVE—ENSCHÉDE.

in consequence of which, he was burned in effigy by the pious Rom. Catholics of Seville, 1660, Apr. 14. During his residence in Spain, E. had considerable reputation as a dramatic poet. According to his own account, he wrote 22 comedies, which had great success on the stage, in consequence of which, several of them passed as Calderon's. *La prudente Abigail*, *Engañar para reinar*, *Celos no ofenden al sol*, and *A lo que obligan los celos*, were published under the name of Fernando de Zárate. E.'s comedies show him to have possessed much inventiveness, but in other respects deserve little praise. Among his writings are *Las Academias morales* (Rouen 1642), containing some fine elegies in verse; *La Culpa del primer peregrino* (Rouen 1644), mystico-theologic poem; *El siglo Pitagórico* (Rouen 1647), series of satirical portraits partly in prose and partly in verse; and *El Sansón Nazareno* (Rouen 1656), an abortive epic. For notice of E. and his writings, see Ticknor's *History of Spanish Literature*.

ENRIVE, v. *ĕn-rīv'* [*en, rive*]: in *OE.*, to cleave; to split. **ENRIVEN**, pp. *ĕn-rīv'n*, cloven or split.

ENROBE, v. *ĕn-rōb'* [*en, robe*]: to clothe; to invest; to attire. **ENROBING**, imp. **ENROBED'**, pp. *-rōbd'*.

ENROCKMENT, n. *ĕn-rōk'mēnt*: stone thrown upon the sea-face of a breakwater or dike, or a shore subject to encroachment of waves or stream.

ENROLL, or **ENROL**, v. *ĕn-rōl'* [F. *enrôler*: *en*, and *role*]: to insert a name in a register or list; to record. **ENROLLING**, imp. **ENROLLED'**, pp. *-rōld'*. **ENROLLER**, n. one who. **ENROLMENT**, n. [F. *enrôlement*]: the act of enrolling or entering into a register; a registering.

ENROOT, v. *ĕn-rōt'* [*en, root*]: in *OE.*, to implant deep; to fix and intermingle different roots. **ENROOTED**, pp. fixed and mingled with their roots one with the other.

ENROUND, v. *ĕn-rownd'* [*en, round*]: in *OE.*, to surround; encircle. **ENROUND'ED**, pp. inclosed by a circle; environed.

ENSAMPLE, n. *ĕn-săm'pl* [OF. *ensample*—from L. *exemplum*]: old form of **EXAMPLE**, which see.

ENSANGUINED, a. *ĕn-săng'gwind* [*en*, and L. *sanguinem*, blood]: soaked or stained with blood.

ENSATÆ, n. *ĕn-să'tē* [L. *ensis*, a sword]: in *bot.*, name given by Linnæus to an order of plants containing the genera *Iris*, *Xyris*, etc. In 1805 Ker gave this name to what are now called *Iridaceæ*—a more restricted use than that of Linnæus.

ENSCHÉDE, *ĕn-schā'dé*: town in the Netherlands, province of Overyssel, four m. from the Hanoverian boundary, 30 m. w.n.w. of Zutphen. Besides fustians and dimities, cottons for export to Java are largely manufactured. Cotton-spinning, bleaching, dyeing, and calendering also employ many of the inhabitants. There are several benevolent institutions; a Reformed, a Rom. Cath., a Bapt. church; a Chamber of Trade, and grammar-school, in

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which French, English, and German are taught. Pop. (1890) 15,615.

ENSCHEDULE, v. *ěn-skĕd'ūl* or *-shĕd'ūl* [*en*, *schedule*]: in *OE.*, to place or insert in a schedule or formal writing. ENSCHEDULED, pp. *-ūld*, inserted in a formal writing.

ENSCONCE, v. *ěn-skōns'* [*en*, in; Dut. *schantse*, a rampart made of trees and branches: Ger. *schanzen*, to make a fence: OF. *esconser*, to hide; *esconse*, a dark lantern (see SCONCE)]: to put one's self behind a screen of some kind; to shelter or cover; to protect; to secure. ENSCONCING, imp. ENSCONCED', pp. *-skōnst'*.

ENSEAM, v. *ěn-sēm'* [*en*; *seam*, to put together by sewing]: in *OE.*, to sew up or in; to inclose by sewing. ENSEAM', v. [*en*; *seam*, grease, tallow]: in *OE.*, to grease. ENSEAMED', pp. *-sēmd'*, greased; greasy. ENSEAM', v. [*en*, *seam*, an apparent corruption of F. *ensemble*, together]: in *OE.*, to gather together; to collect.

ENSEAR, v. *ěn-sēr'* [*en*, *sear*]: to stop or stanch by rubbing with fire or a very hot iron; to cauterize.

ENSEMBLE, n. *āng-sām'bl* [F. *ensemble*, the whole—from L. *insimul*, at the same time]: the whole so seen that each part is only viewed in reference to the whole; details of anything viewed with relation to each other; the general grouping of characters in dramatic art to form a picture on the fall of the curtain; whole effect of the various parts of a musical performance. TOUT ENSEMBLE, *tūt-* [F. *tout*, all—from L. *totus*, the whole]: the whole together; the general appearance or effect.

ENSHIELD, a. *ěn-shēld'* [*en*, *shield*]: in *OE.*, covered or concealed as with a shield or mask.

ENSHRINE, v. *ěn-shrīn'* [*en*, and *shrine*]: to inclose in a covering or chest; to preserve as sacred. ENSHRI'NING, imp. ENSHRINED', pp. *-shrīnd'*.

ENSHROUD, v. *ěn-shrōwd'* [*en*, and *shroud*]: to cover or envelop in a shroud. ENSHROUD'ING, imp. ENSHROUD'ED, pp.

ENSIFORM, a. *ěn'sī-fawrm* [L. *ensis*, a sword; *forma*, a shape]: in *bot.*, in the form of a sword, as the leaves of the gladiolus; in *anat.*, applied to the xiphisternum or cartilage in which the breast-bone ends.

ENSIGN, n. *ěn'sīn* [F. *enseigne*; OF. *ensigne*, a distinctive mark—from L. *insigniā*, plu. of *insignē*, that has a mark upon it, distinguished—from L. *en*, in; *signum*, a mark impressed]: the banner or flag of a regiment; the infantry officer who carries the flag of a regiment; a mark of rank or office; the national flag of a ship. ENSIGN-BEARER, he who carries the flag. EN'SIGNCY, n. *-sī*, the rank or commission of an ensign.—*Ensign* was, until 1871, the title of the lowest commissioned officers in the British army, from their carrying the regimental colors or ensign. In the hand-to-hand mêlées of the middle ages, the preservation of the colors or standard, as the rallying-point of those fighting under the same leader, was a matter of vital importance, and was

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intrusted only to the bravest and most trustworthy. The colors were committed to him with imposing ceremony in presence of the assembled regiment, and he had to take an oath to defend them with life and limb, and if need were, to wrap himself in them as a shroud, and devote himself to death. The man who undertook this perilous post received sometimes sixfold the usual pay. It was doubtless in this way that the point of honor arose respecting the colors. History records repeated instances where the oath was kept to the letter. In the modern system of warfare, the regimental colors are seldom exposed to such danger, and the office of ensign is of less account. When a gentleman entered the British army, he began as an ensign (if in the infantry), and from this rank he rose by purchase or seniority: see COMMISSIONS, ARMY. The rank of ensign has been abolished in the British army.—ENSIGN is the name also of one of the flags belonging to the British fleet; it is a large flag or banner hoisted on an ensign staff, a long pole erected over the poop, or at the gaff when the ship is under sail. Its chief purpose is to denote the nation to which the ship belongs. The English ensign has for a groundwork one of three colors—red, white, or blue—and bears the Union double cross of St. George and St. Andrew, or Union-Jack (q.v.); in the upper corner next the mast (dexterchief). The *white* ensign also is divided into four quarters by a red cross of St. George, and is limited to ships-of-war. Merchant-vessels are allowed to carry only the *blue* ensign; but yachts, if of clubs acknowledged by the admiralty, colonial armed vessels, ships connected with government departments, and merchant-vessels commanded by officers of the Naval Reserve, are permitted to use the *red* ensign. Formerly, the English admirals required ships of all other nations to dip their ensigns to the English flag: the refusal of the Dutch to comply with this custom, was the signal for one of Blake's bloodiest encounters with Van Tromp.

In the *U. S. army*, the national and regimental flags are carried by sergeants selected by the col., and the troop and battery guidons by corporals selected by the captains: see COLOR (COLOR-GUARD: COLOR-SERGEANT): also FLAG: STANDARD.—In the *United States navy*, the national flag is the ensign. Merchant vessels also carry the flag of the nation.

ENSILAGE.

ENSILAGE: process of preserving green forage in an air and water-tight excavation or building called a silo. The term is applied also to the material thus preserved. Though only recently brought into prominence, the process is of ancient and unknown origin. There is evidence that the Romans stored green forage, as well as ripened grain, in pits which they covered with earth; but whether they discovered this method or adopted it from some of their conquered tribes is uncertain.

To preserve forage crops for any length of time it is necessary to prevent the fermentation and subsequent decomposition which a mass of green vegetable matter will naturally undergo. This can be accomplished by excluding either moisture, heat, or air. In preparing grass and similar material for winter use it is the common custom to expel the moisture by drying in the sun. Keeping the fodder at a very low and uniform temperature would answer the same purpose, but for farm uses is manifestly impracticable. Exclusion of air from the material is equally efficient, and is the method adopted in ensilage.

The method of making E., or 'sour hay,' as it was called, long in use in various countries of the old world, is to dig a pit, place the green fodder therein, and cover with earth. The results are neither uniform nor satisfactory. In 1850 Auguste Goffart, of France, commenced a course of study and experiment which extended over more than a quarter of a century in an endeavor to devise a method which should permanently keep green forage in perfect condition. He at length succeeded by making the silo air and water-tight, cutting the material in short pieces so that it would pack closely, and using a heavy cover which, as the mass settled would exert a continuous pressure. In 1876 the French govt., as a recognition of his valuable discovery, conferred upon him the decoration of the Legion of Honor. The following year he published a book fully describing his method. J. B. Brown, of New York City, rendered American farmers an important service by translating this work, which he published 1879 with other matter relating to the subject. Previous to this, Francis Morris, of Md., and C. W. Mills, of N. J., had buried green corn in trenches, and O. B. Potter, of New York, had, 1877, built a large silo of masonry (the first of the kind in this country), which he filled with corn and covered with earth. But it was not until after the publication of Goffart's work that any considerable interest in the subject was manifested. In 1880 about 50 silos were built in various parts of the country, and filled with E.: the results were satisfactory and the value of the system was demonstrated.

When preserved in a silo, fodder is much more valuable than when dried in the sun. While in theory grass loses none of its nutritive qualities in drying, the fact remains that it is much better food for stock than hay. Cattle fatten rapidly in rich pastures, but cannot be made to do so on good hay. If cows are taken from good pastures and kept on the best of hay, the yield of milk is decreased and the quality of the butter therefrom is impaired. Either

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there is a loss of nutriment in drying, or the hay is not so digestible as the grass. But when green forage is kept in a silo there is no appreciable loss of its valuable qualities. If fed with E., young stock can be kept constantly growing and the productiveness of cows can be maintained at the maximum of their capacity. The labor of securing the fodder is decreased, and losses from exposure to storms, imperfect curing, or over-ripeness, are easily avoided. As a large quantity of fodder can be grown on a small area, the use of E. will enable the farmer to keep more stock, produce more beef and milk, increase the quantity of manure, and in a few years bring his land to a high state of fertility. This system also enables the farmer to provide for times of drought as well as for winter feeding, and to prevent losses which at such periods under the ordinary method are inevitable. Only about one-fourth of the space is required for storage, and the fodder is in better condition to use. The system is adapted to all parts of the country. Sufficient heat is generated to keep the contents of the silo from freezing at the North, while at the South there is no difficulty in keeping the E. uninjured by heat.

The first silos constructed in this country were elaborate and costly, but experiments have shown that a silo answering all practical purposes can be built at small expense. Machinery for cutting the E. can be owned and used by several neighbors in common, thus reducing this item to a small sum. To insure perfect drainage a trench should be dug around the silo, about 12 inches outside of the wall, and several inches below the foundation. If built of masonry one-half the depth can be below the surface of the ground. The bottom should be covered with cement, and the doors made double and air-tight. A silo 32 ft. long, 16 ft. wide, and 16 ft. deep, inside measure, will hold about 185 tons of E. and cost \$1.50 to \$5.00 per ton capacity, according to the location and the materials used. The walls must be perfectly true and smooth inside in order that the weighted cover may fit closely and yet pass down without obstruction as the E. settles. If built of wood the cost will be much less. The frame must be strong, and iron rods should be used to keep the sides from spreading when the silo is filled. The studding should be two by ten inches, covered, both outside and inside, with tarred paper, which should be well lapped. The inside should be covered with matched boards and the outside closely boarded. The dead air space is sometimes filled with sawdust, but this is unnecessary.

Indian corn designed for ensilage should be cut as soon as the kernels begin to glaze, grain when it is in the milk, and grass when it begins to blossom. The material should not be allowed to wilt, but should be removed from the field as soon as cut, and run through a machine which will divide it into short pieces. From four to five-tenths of an inch is probably the best length, as the E. packs more closely and requires less pressure than it does when cut in inch or inch and one-half pieces. The machine should be located so that an endless belt will deposit the material in the silo as

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fast as it is cut. It should be evenly spread and, in order to cause it to settle uniformly, may be lightly tramped at the sides and corners. The cover is usually put on at once. Perhaps a better method is to fill the silo as quickly as possible, but leave it uncovered until the temperature of the contents rises to about 125°. This will be in from two to six days, according to the weather. The cover should then be put on and properly weighted. It is claimed that the heating destroys the germs of fermentation, and that the E. will be much sweeter and better than if covered as soon as the silo is filled. The covering should be of planks about an inch shorter than the space between the walls. A little space should be left between them for the escape of the air contained in the E. when it is stored. They can be weighted with stones, bags of grain, or any convenient material. If the E. is cut in pieces four or five-tenths of an inch long, a pressure of 100 lbs. per sq. ft. will be sufficient; but if the pieces are an inch and a half long about twice as much weight will be required. Corn E. will settle about one-third, and will weigh about 46 lbs. per cubic foot. Grass packs more closely, and will weigh about 48 lbs. per cubic foot. E. will be ready for use in about two months after being put in the silo, but will keep indefinitely. If properly managed, fermentation does not go beyond the saccharine stage; but when removed from the silo and exposed to the air alcoholic fermentation soon begins. It is then in the best condition to feed. Only a small portion of the silo should be uncovered at a time. The E. should be cut down from the top with a hay knife, and no more than is needed for one day should be removed at once.

Early experiments with E. were made almost wholly with Indian corn. Later tests proved that clover, rye, oats, peas, millet, grasses, and various other forage plants are valuable for this purpose, though more expensive than corn. It has been proved that corn can be grown and put into the silo for from one to two dollars per ton, and that 30 tons can be grown on an acre of land. As three tons of good corn E. are equal in feeding value to one ton of first-class hay, it is plain that E. is far cheaper than hay can be produced. Corn E. is an excellent substitute for hay and roots, but being somewhat deficient in albuminoids and phosphates, should be fed in connection with a small quantity of meal or bran, or with E. composed of clover or similar substances. From six to seven per cent. of its live weight of corn E., and three to six pounds of meal or bran, may be considered a fair daily ration for a grown animal. **ENSILATE**, v. *ĕn'sil-ăt*, to bury grain, green fodder, or forage crops in a foss or trench for the purpose of preserving them.

ENSISTERNAL, a. *ĕn-si-stér'nal* [L. *ensis*, a sword; mod. L. *sternum*—from Gr. *sternon*, the breast or chest]: in *anat.*, pertaining or relating to the ensiform process of the sternum.

ENSKIED, a. *ĕn-skīd'* [*en, sky*]: in *OE.*, made immortal; raised to, or placed in, the skies or heaven.

ENSLAVE—ENTABLATURE.

ENSLAVE, v. *ěn-slāv'* [*en*, and *slave*]: to deprive of liberty; to reduce to bondage; to hold in subjection. ENSLAVING, imp. ENSLAVED', pp. *-slāvd'*. ENSLA'VER, n. one who. ENSLAVE'MENT, n. state of being enslaved; bondage.

ENSNARE, v. *ěn-snär'* [*en*, and *snare*]: to entrap; to take by guile. ENSNA'RING, imp. ENSNARED', pp. *-snärd'*: also INSNARE: see INSNARE.

ENSNARL, v. *ěn-snárl'* [*en*, and *OE. snarl*, Scot. *snorl*, a difficulty, a snare]: in *OE.*, to entangle, as thread; to entangle; to insnare. ENSNARL'ING, imp. ENSNARLED', pp. *-snárl'd'*.

ENSTATITE, n. *ěn'sta-tīt* [Ger. *enstatit*—from Gr. *enstatēs*, an adversary: so named because so refractory]: in *mineral.*, an orthorhombic mineral. Its lustre is vitreous, except on the cleavage surfaces, on which it is pearly; colors are white, green, or brown; streak is gray. It is possessed of double refraction; composition: silica, 60; magnesia, 40. There are two varieties: (1) E. proper, white, with little or no iron; chladnite falls under this; (2) Ferriferous E., called also bronzite; containing iron; green or brown; found in Bavaria, Moravia, Penn., Tex., etc.

ENSUE, v. *ěn-sū'* [OF. *ensuir*, to ensue: F. *ensuivre*, to follow—from L. *insēquī*, to follow upon—from *in*, in; *sēquor*, I follow]: to follow as a consequence; to succeed; to come after. ENSU'ING, imp.: ADJ. coming next after; following as a consequence. ENSUED', pp. *-sūd'*.

ENSURE, v. *ěn-shōr'*: see INSURE.

ENTABLATURE, n. *ěn-tăb'lă-tür*; or ENTABLEMENT, n. *ěn-tăb'l-měnt* [OF. *entablature*; F. *entablement*—from *en*, in; L. *tabūlā*, a board or table]: in *classic architecture*, that part of a design which surmounts the columns (q.v.), and rests upon the capitals. It is usually about two diameters of the column in height, and is divided in every style of classical architecture into three parts—architrave, frieze, and cornice. These parts vary in their relative proportions in different styles. In Doric architecture, for example, if the E. be divided into eight equal parts, two of these form the height of the architrave, three that of the frieze, and three that of the cornice. In the other styles, the relative proportions are as three, three, and four.

The term E. was not used till the 17th c., the members composing it being previously simply designated the cornice, frieze, and architrave.

1. *The Architrave* is the horizontal portion which rests immediately upon the abacus of the column. It is usually ornamented with horizontal moldings, with flat spaces or *fasciae* between. The upper molding always projects further than the others, so as to throw off the rain. This molding varies in different styles. In Doric (fig. 1), it is a plain square projection, with small pendants or *guttæ* under the triglyphs. In the other styles it is generally an ogee, or talon molding. These moldings are frequently enriched with

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leaf ornaments, and in very florid designs the faciae also are enriched.

2. *The Frieze* is the middle portion of the E., between the top of the architrave and the bed of the cornice. In the

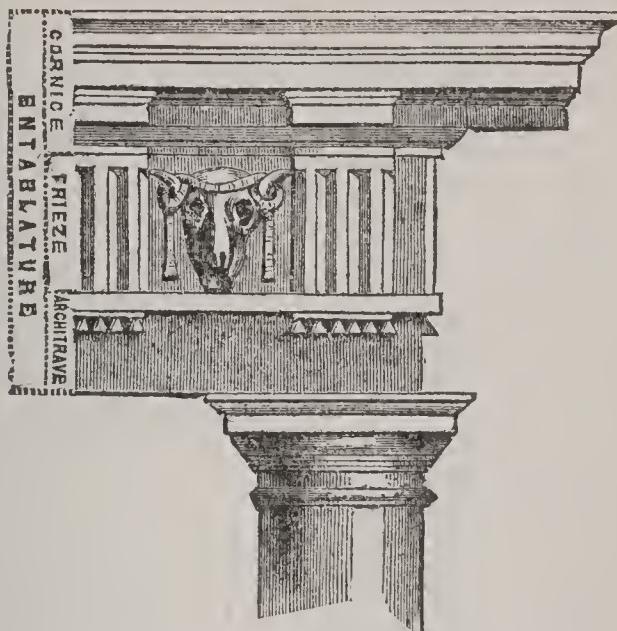


Fig. 1.—Example of Doric Entablature.

Doric style, it is ornamented with triglyphs or slight projections, divided by angular grooves into three parts. The spaces between the triglyphs (called metopes) are square, and are either plain or enriched, either with figure-sculpture, as in the Parthenon, or with bulls' heads, pateræ, or other ornaments. In the other styles, the frieze is never cut into portions, but is either left quite plain or ornamented with figure-sculpture or scroll-work. The former is usual in Greek art, the latter in Roman. In late Roman works, the frieze is sometimes swelled or made to project with a curve.

3. *The Cornice* forms the upper portion of the E. It is divided into several parts. The lower molding or moldings resting on the frieze are called the bed-moldings—the upper projecting part is called the corona (q.v.), and between the two there are frequently introduced modillions and dental bands. The bed-molding is generally of an oval or echinus form, and is frequently enriched with the egg and tongue or leaf ornaments. The upper molding of the corona is generally of a *cyma recta* form (see COLUMN, fig. 1), and is often ornamented with lions' heads. These represent the openings through which the rain was at first led off from the roof-gutters, which were cut in the top of this molding, and were retained as ornaments after their original use was discontinued. The corona projects well over the frieze and architrave, and protects them from rain, while by its broad shadow, it gives repose and variety of effect to the building. The *soffit*, or underside of the corona, is frequently panelled and ornamented with pateræ.

Origin.—The component parts of the E. are said, with some appearance of truth, to owe their origin to the forms of the construction of the oldest temples. These were of wood, and were put together in the manner most natural

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for that material. The square beams laid across from post to post are represented by the architrave; the triglyphs of the frieze are copied from the ends of the cross-beams; the cornice is taken from the boarding which covered the rafters and ties of the roof—projected so as to throw off

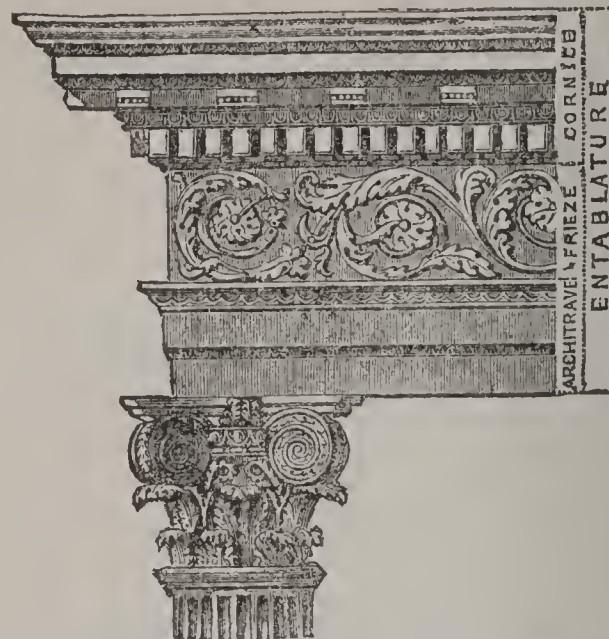


Fig. 2.—Example of Composite Entablature.

the rain; and the dentils and modillions show the ends of the rafters left uncovered.

Whatever the origin of the E., it is remarkable, as connected with Greek and Roman art, how persistent the E. was as a feature in the decoration of these classic styles. So long as buildings consisted of one story in height, this was quite natural; but after this simple system was abandoned, and when, as in Roman architecture, series of columns and entablatures were piled one above the other—not used constructionally, but simply applied to the face of the building—the cornice, frieze, and architrave still retained their places and proportions. In the revived Roman art of the 16th c., the E. was used in a manner still further removed from its original purpose (fig. 2.). The strict proportions of the various parts were entirely lost sight of. The frieze was increased in height, so as to admit of small windows, to light the entresol or Mezzanine (q.v.), and in the French and English forms of the renaissance, the various members become still more attenuated and altered from the original design (see RENAISSANCE). But in no modification of classic architecture, however debased, is the E. lacking. The architrave, frieze, and cornice are essential portions of every classic design.

ENTADA, *ĕn-tā'da*: genus of climbing shrubs of the nat. ord. *Leguminosæ*, suborder *Mimosæ*, having pinnate or bipinnate leaves, and remarkable for their great pods, in which the seeds lie amidst a glutinous or gelatinous substance. The seeds of *E. pursætha*, an E. Indian species, are saponaceous, and the plant attains great size, sometimes having pods five ft. long and six inches broad.

ENTAIL.

ENTAIL, v. *ĕn-tāl'* [F. *entailleur*, to cut, notch, or carve—from *en*; *tailler*, to cut—*lit.*, to cut from the power of a testator, as to the disposal of an estate]: to fix the succession of lands or tenements to a certain line of descendants, so that the one in possession can neither sell nor burden them except by legal process under an act of parliament, and with the consent of the next two heirs; to fix as an inevitable consequence on persons or things: N. lands or tenements limited in descent; the settled rule of descent for an estate. ENTAIL'ING, imp. ENTAILED', pp. *-tăld'*: ADJ. settled on a person and his descendants. ENTAIL'MENT, n. the act of settling inalienably an estate on a person and his heirs.

ENTAIL, or ENTAYLE, v. *ĕn-tāl'* [It. *intaglio*, which see]: in *OE.*, to carve: to cut: N. a stone or gem with the design cut out or hollowed; in *old English authors*, any architectural ornament, sculptured or cut in stone; an intaglio. ENTAIL'ING, imp. ENTAILED', pp. *-tăld'*.

ENTAIL' (frequently called in Scotland, *tailzie*): any destination by which the legal course of succession is cut off, one or more of the heirs-at-law being excluded or postponed, and the settlement of land made upon a particular heir or series of heirs. The desire to preserve in a family land which has been either inherited or acquired, appears inherent in the human mind. The first distinct trace of the existence of entails, is found in the Roman law. The Greeks, indeed, permitted persons to name successors to their estates, and to appoint a substitute who should take the estate on the failure of him first named. The substitute, as appointed, was permitted to succeed on the death of the institute (as he was called) without leaving issue or without alienating the estate. But this limited right fell far short of the power of entailing which has since prevailed in various countries. At Rome, under the later emperors, the practice of settling land upon a series of heirs, by means of *Fideicomissa* (q.v.), grew up, and was sanctioned by the state. These deeds, which were originally simply a trust reposed in the honor of a friend, to whom the property was conveyed, to carry out the will of the grantor, by degrees received the sanction of the law. In their early form, they contained merely a substitution of heirs. But by the later law, a much fuller form of settlement was admitted, whereby the estate was protected from every sort of alienation. It is impossible to doubt that the later Roman form must have been adopted by the Scottish lawyers in framing their deeds of entail. The limitation to a particular line of descent, the prohibition to alienate or burden with debt, and the still more peculiar feature of the declaration of forfeiture in case of non-compliance, are in both forms. There are, however, two points in which the Roman law differed from that which prevailed for many years in Scotland—viz., that the former did not recognize the right of primogeniture, and that after the legislation of Justinian, the limitation of the deed was restricted to four generations. The right of primogeniture, as recognized in deeds of entail, originated with the feudal

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law. That system, which has united with the civil law to form a basis for the codes of modern Europe, did not, in its original form, recognize the right of a holder of land to alienate his feudal benefice, or even to alter the succession, because on the failure of heirs the feu returned to the superior. But the right of the eldest son to represent his father, both in the duties and in the privileges of the fief, if not an original principle of the system, was universally recognized in the days of its greatest power. We shall presently see how this principle was embodied in a Scottish deed of entail.

In England, the Saxons, it is said, prohibited the alienation of lands by those who had succeeded to them under condition that they should not alienate.—Wilkins's *Leges Saxonicae*, p. 43 (note). Among the Saxons, the law of primogeniture was not recognized. But on the establishment of the feudal laws in England, a practice began to prevail whereby an estate was settled upon a particular series of heirs. The judges, however, refused to recognize an absolute limitation of the estate to a particular line of heirs, but held the destination to be conditional on the birth of an heir, and that that condition having been fulfilled, the donee was free to alienate the estate. The common law thus refusing to recognize entails, a statute was passed which had the effect of introducing that practice into England. This was the famous statute *De Donis* (see DONIS CONDITIONALIBUS). One of the forms of E. under this statute was by settlement in Frankmarriage (q.v.). For nearly 200 years the statute *De Donis* was operative for strict E. But the tendency which in Scotland was to strengthen the power of entails, was in England in the opposite direction. For a long time tenants in tail, through legal technicalities, were able to defeat the limitation in tail by means of a Discontinuance. For more than 300 years from the introduction of common recoveries, E. could be barred if the tenant in tail and the next heir chose to combine to defeat it. In 1833 the technicalities formerly necessary were removed, and a tenant in tail may now, by a simple conveyance, alienate his estate at pleasure, at least where there is a possibility of issue. Under the modern settlement, where the estate tail is preceded by a life interest, the consent of the tenant for life is required to bar remainders and reversions. An estate tail is a freehold of a limited nature. Tenant in tail may commit waste (q.v.). An estate tail is liable to the debts of the tenant. Copyhold lands have been held not to fall under the operation of the statute *De Donis*. The laws against Perpetuities (q.v.) prevent tying-up of property for an indefinite period; but in fact family estates are usually resettled by the owners in each generation. Lord Cairns's Settled Land Act, 1882, has given to tenants for life absolute power of sale on notice to the trustees of the settlement, and without petition to the court, the price being invested for the persons interested under the settlement. By a series of statutes in England, tenants for life have also received large powers of managing and improving their estates.

ENTANGLE—ENTELLUS MONKEY.

In America, before the separation from the mother-country, the English law as to estates tail prevailed. But in the United States, the law of E. has been gradually abandoned by the several states; and property can now be fettered, to a very limited extent only, by executory devises (q.v.). In France, the power of creating E. has varied much at different periods, from the right to make a perpetual E., which appears to have been the original principle, to a limitation to four, and at one time to two degrees. But by the Code Napoleon, ss. 896–897, entails are now absolutely prohibited. In Spain, also, entails, formerly permitted under certain restrictions, were abolished 1820.

See M'Culloch's *Treatise on the Succession to Property vacant by Death*; Williams's *Principles of the Law of Real Property*; Sandford's *History and Law of Entail in Scotland*; Reports by H. M. Consuls on Systems of Land Tenure, 1870; and Cobden Club Essays, on same subject. See also Lavaleye, *De la Propriété primitive*, and Garsounet, *Histoire des Locations perpétuelles*.

ENTANGLE, v. ēn-tāng'gl [en, in, and tangle]: to twist and intermingle so as not to be easily separated; to involve; to confuse; to bewilder; to puzzle; to perplex. **ENTANGLING**, imp. -glīng. **ENTANGLED**, pp. -gld. **ENTANGLEMENT**, n. -gl-mēnt, a disordered state; perplexity; military obstacles formed by bending down and picketing a series of adjacent saplings, with large trees partially cut down, or with wire passed over stout stakes set at different distances.

ENTASIA, n. ēn-tāzhī-ā [Gr. *entasis*, distension, a violent straining]: in *med.*, a vehement straining or stretching—applied as a general term for constrictive spasm, tetanus, etc. **ENTASTIC**, a. -tās'tik, relating to diseases characterized by tonic spasms. **ENTASIS**, n. ēn'tū-sis, in *arch.*, the gradual swelling outline given to a shaft or column (q.v.).

ENTELECHY, n. ēn-tēl'ē-kī [Gr. *entelecheia*—probably from *en telei echein*, to be complete or absolute]: term introduced by Aristotle to signify actual as distinguished from merely potential existence; the first of which he defined as the state of being complete or finished; the second, as the activity of that which is thus complete.—E. in *mod. phil.*, is the name which Leibnitz gave to the monads of his system.

ENTELLUS MONKEY, ēn-tēl'ūs, or **HANUMAN**, hōn'-ū-mān (*Semnopithecus Entellus*): E. Indian species of monkey, with yellowish fur, face of violet tinge, surrounded with projecting hairs, long limbs, and very long muscular and powerful—though not prehensile—tail. It is held in superstitious reverence by the Hindus, and is often seen exhibiting much impudent familiarity in the precincts of temples; indeed, temples are often specially dedicated to it; hospitals are erected for its reception when sick or wounded. Hindu laws affix a far more severe punishment to the slaughter of one of these sacred monkeys than of a man; the peasant esteems it an honor when his garden is plundered or his house robbed by troops of them.

ENTER—ENTERIC.

and would consider it an act of the greatest sacrilege to drive them away. This is one of the very few species of monkeys found in the n. provinces of India, and in



Entellus Monkey (*Semnopithecus Entellus*).

summer it ascends the Himalaya to the pine-forests, and almost to the snow-line; it has even succeeded in crossing the mountains, and occurs in Bhotan.

ENTER, v. *ĕn-tĕr* [F. *entrer*—from L. *intrārĕ*, to walk into, to enter: F. *entre*; L. *iuter*, between, among: It. *entrare*]: to go or pass into a place; to begin or commence; to engage in; to join or become a member of; to set down in writing; to enroll; to flow into; to pierce. EN'TERING, imp.: N. a passing in; an entrance. EN'TERED, pp. *-tĕrd*: ADJ. enrolled; introduced. EN'TRANCE, n. *-trāns*, power or right to enter; the door; the beginning: ADJ. that which allows to enter: preliminary. ENTRANT, n. *ĕn'trānt*, one who enters. ENTERCLOSE', *-klōz'*, in arch, passage between two rooms in a house, or leading from the door to the hall. To ENTER SHORT, to pay a bill not due into a bank merely for collection, and not for entry to the credit of any account.

ENTERDEAL, n. *ĕn'tĕr-dĕl'* [F. *entre*, between—from L. *intra*; Eng. *deal*, conduct, intercourse]: in *OE.*, mutual dealings or transactions; reciprocal practices.

ENTERIC, a. *ĕn-tĕr'ĭk* [Gr. *entērōn*, an intestine]: belonging to the intestines. ENTEREPIPLONPHAL'OCELE, n. *-ĕp-i-plōm-făl'ō-sĕl* [Gr. *epiploon*, the omentum; *omphalos*, the navel; *kēlē*, a tumor]: hernia of the umbilicus, causing protrusion of the omentum and part of the intestines. EN'TERITIS, n. *-i'tis* [*itis*, a postfix denoting inflammation]: inflammation of the intestines. ENTER'OCELE, n. *-ō-sĕl* [Gr. *kēlē*, a tumor]: a hernial tumor containing a loop of the intestine. ENTEROCYS'TOCELE, n. *-sīs-tō-sĕl* [Gr. *kystis*, a bladder; *kēlē*, a tumor]: hernia affecting the bladder and an adjacent portion of the intestine. ENTERO-EPIP'LOCELE, n. *-ĕ-pip'lō-sĕl* [Gr. *epiploon*, the omentum; *kēlē*, a tumor]: rupture produced through a tumor, so that both the

ENTERITIS.

omentum and intestines protrude from the body. ENTEROGRAPHY, n. -*ög'rā-fī* [Gr. *graphē*, a writing]: branch of anatomy which describes the intestines. ENTERO-HYDROCELE, n. -*hī'drō-sēl* [Gr. *hudōr*, water; *kēlē*, a tumor]: internal hernia, complicated with hydrocele. ENTERO-ISCHIOCELE, n. -*is'ki-ō-sēl* [Gr. *ischion*, the hip-joint; *kēlē*, a tumor]: ischial hernia, formed by the adjacent intestine. ENTEROLITH', n. -*ō-lith'* [Gr. *lithos*, a stone]: a concretion resembling a stone found in the intestine. ENTEROLOGY, n. *ēn'tér-ōlō-jī* [Gr. *logos*, discourse]: a treatise or discourse on the internal parts of the body. ENTEROMER'OCELE, n. -*mēr'ō-sēl* [Gr. *mēros*, the upper fleshy part of the thigh; *kēlē*, a tumor]: crural hernia, formed by the adjacent intestine. ENTEROMESENTER'IC, a. -*mēs ēn-tér'ik*, pertaining or relating to the mesentery and to the intestines. ENTEROMORPHA, n. *en-tér-ō-mawr'fa* [Gr. *morphē*, form, shape]: genus of algals, order *Confervaceæ*, tribe or family *Acetabularida*. Some are marine, some fresh-water species, while one, *E. intestinalis*, grows both in the sea and in fresh water. ENTEROPHALOS, n. -*ōm'fā-lōs* [Gr. *ōm-phālos*, navel]: an umbilical hernia whose contents are intestine. ENTEROPATHY, n. -*ōp'a-thī* [Gr. *pathē*, passive state, suffering]: disease of the intestines. ENTEROPERISTOLE, n. -*pēr-is'to-lē* [Gr. *peristole*, a dressing out or up]: strangulation of part of the intestine in a hernia or otherwise. ENTERORRHAPH'IA, n. -*rāf'i-ā* [Gr. *raphē*, a seam, a suture]: suture of part of the intestines, which has been ruptured or otherwise divided. ENTEROSAR'COCELE, n. -*sār'ko-sēl*, intestinal hernia, complicated with sacrocele. ENTEROS'CHEOCELE, n. -*ōs'kē-o-sēl* [Gr. *oscheos*, the scrotum; *kēlē*, a tumor]: scrotal hernia, formed solely by the intestine. ENTEROTOME, n. *ēn'tér-o-tōm* [Gr. *temnō*, I cut]: instrument for opening the intestinal canal through the whole extent. ENTEROT'OMY, n. -*ōt'ō-nī* [Gr. *tōmē*, a cutting]: the act or art of dissecting the intestines.

ENTERITIS: inflammation of the bowels, especially of their muscular and serous coat, leading to constipation (q.v.) and pain, with colic (q.v.), and sometimes ileus (q.v.). E. is distinguished from these last affections, indeed, only by the presence of inflammatory symptoms—i.e., pain, tenderness, fever, etc., from a very early stage of the disease, and in so decided a form as to require special attention. If E. does not ensue from mechanical obstruction, it may be combated by hot fomentations, with moderate leeching and counter-irritation, and the internal administration of opium. Injections of warm water, or of asafœtida and turpentine (see CLYSTER), should be at the same time given to clear the lower bowel; and all purgatives, except in some cases castor oil, should be avoided. The disease is, however, one of great danger, and should never be incautiously treated with domestic remedies. It is closely allied to peritonitis (q.v.), and often depends upon internal mechanical causes, or on external injury.

In the Lower Animals.—Inflammation of the bowels, among the heavier breeds of horses, generally results from some error of diet, such as a long fast followed by a large,

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hastily devoured meal, indigestible or easily fermentable food, or large draughts of water at improper times. When thus produced, it is frequently preceded by stomach staggers or colic, affects chiefly the mucous coat of the large intestines, and often runs its course in eight to twelve hours. With increasing fever and restlessness, the pulse soon rises to 70 or upward, and, unlike what obtains in colic, continues throughout considerably above the natural standard of 40 beats per minute. The pain is great, but the animal, instead of recklessly throwing himself about, as in colic, gets up and lies down cautiously. Respiration is quickened, the bowels are torpid. Cold sweats, stupor, and occasionally delirium, precede death. When connected with, or occurring as a sequel to influenza, laminitis, and other diseases, the small intestines are as much affected as the large, and the peritoneal as well as the mucous coat of the bowels. This form is more usual in the lighter breeds. When the patient is seen early, while the pulse is still clear and distinct, and not above 60, and the legs and ears warm, bloodletting is useful, as it relieves the overloaded vessels, and prevents that exudation of blood which speedily becomes poured out in the interior of the bowels. This disease should be treated as follows: In a pint of oil, or an infusion of two drachms of aloes in hot water, give a scruple of calomel and an ounce of laudanum, and repeat the calomel and laudanum every hour in gruel until the bowels are opened, or five or six doses are given. Encourage the action of the bowels by using every half hour soap and water elysters, to which add laudanum so long as pain and straining continue. If the animal is nauseated and stupid, with a cold skin, and a weak quick pulse, bleeding and reducing remedies are very injurious; and the only hope lies in following up one dose of the calomel and aloes with small doses of laudanum and sweet spirit of nitre, or other stimulants, repeated every 40 minutes. In all stages, woolen cloths wrung out of hot water and applied to the belly encourage the action of the bowels, and relieve the pain.

E. in cattle is produced mostly by coarse wet pasture, acrid or poisonous plants, bad water, and overdriving. The symptoms are fever and thirst, a quick but rather weak pulse, restless twitching up of the hind limbs, tenderness of the belly, and torpidity of the bowels. Calves generally die in three or four days, other cattle in a week or nine days. Bleed early, open the bowels with a pint of oil and a drachm of calomel, which may be repeated in eight or ten hours, if no effect is produced. Give every hour fifteen drops of Fleming's tincture of aconite in water, until six or seven doses are given. Allow only sloppy and laxative food, such as treacle, gruel, or a thin bran mash; employ elysters and apply hot cloths to the belly, and use two-ounce doses of laudanum if the pain is great. E. in sheep is caused by exposure to storms and cold, over-feeding, eating acrid plants, or by a sudden change of food. In early stages it resembles colic, but is less amenable to treatment. Pain is severe, abdomen

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tender, pulse quick, urine high-colored, bowels are obstinately constipated, and nose and feet are cold. Purgatives in large doses, together with anodynes, should be administered in a mucilage of slippery elm bark or gum arabic. In very mild cases injections of warm water may be sufficient. After the febrile stage is passed tonics are required. Mucilaginous drinks and warm bran mashes should be given during convalescence.

ENTERODELA, n. *ěn-tér-o-dě'la* [Gr. *enteron*, an intestine; *dēlos*, manifest, visible]: name given by Ehrenberg to a section of his polygastric infusoria, in which the alimentary canal, which is conspicuous, has an aperture at each end.

ENTERORRHŒA, n. *ěn'tér-ō-rē'ă* [Gr. *entérōn*, an intestine; *rheō*, I flow]: an abnormal increase of the secretions of the mucous glands of the intestines.

ENTEROZOA, n. plu. *ěn'tér-ō-zō'ă* [Gr. *enteron*, an intestine; *zōōn*, an animal]: a general name for the intestinal parasites which infest the bodies of animals.

ENTERPRISE, n. *ěn'ter-prīz* [F. *entreprise*, an undertaking—from F. *entre*, between; *prise*, a taking]: anything attempted to be performed; an undertaking; any bold or hazardous undertaking; boldness; energy: V. in *OE.*, to undertake; to essay; to receive. EN'TERPRI'SING, a. bold; resolute; active. EN'TERPRI'SINGLY, ad. -*lī*.

ENTERTAIN, v. *ěn'tér-tān'* [F. *entretenir*, to hold in talk, to hold together—from F. *entre*, between; *tenir*, to hold—from L. *tenērē*, to hold—*lit.*, to hold in talk]: to treat with hospitality; to amuse or instruct by conversation; to cherish or harbor in the mind; to please or divert. EN'TERTAIN'ING, imp.: ADJ. pleasing; amusing; diverting: N. in *OE.*, entertainment. EN'TERTAINED', pp. -*tānd'*. EN'TERTAIN'ER, n. one who gives the rites of hospitality to a guest: one who amuses or diverts. EN'TERTAIN'MENT, n. hospitable reception; a feast; a repast; amusement; in *OE.*, the state of being in pay, as soldiers or servants; a dramatic performance; pleasure or amusement from conversation. EN'TERTAIN'INGLY, ad. -*lī*.—SYN. of ‘entertain’: to amuse; maintain; support; accept; harbor; cherish;—of ‘entertainment’: diversion; recreation; sport; pastime; banquet; carousal; meal; admission; reception; pay; wages.

ENTERTISSUED, a. *ěn'tér-tiš'hūd* [F. *entre*, between, and *tissue*]: in *OE.*, interwoven and intermixed with various colors and substances.

ENTHELMINS, n. *ěn-thē'l'mīns* [Gr. *entos*, within; *helmins*, a worm]: an intestinal worm. ENTHELMINTHA n. -*mīnθ'a*, the presence of intestinal worms, or their presence in larger numbers than usual.

ENTHOPHYLLOCARPI, n. *ěn-tho-fīl-lo-kār'pī* [Gr. *enthen*, on the one side and the other; *phullon*, a leaf; *karpos*, fruit]: a division of *Bryaceæ* (True Mosses) in which the lateral or terminal theca springs from a duplication of the leaves.

ENTHRALL—ENTITLE.

ENTHRALL, v. *ĕn-thrāl'*: same as INTHRALL, which see. ENTHRAL MENT, n. a state of slavery; servitude.

ENTHIRONE, v. *ĕn tūrōn'* [en, in, and *throne*: OF. *enthroner*, to enthrone]: to invest with sovereign authority; to install a bishop. ENTHRO'NING, imp. ENTHRONED', pp. *-thrōnd'*, seated on a throne; regal. ENTHRO'NIZATION, n. *-nī-zū'shūn*, or ENTHRONE'MENT, n. the induction or installation of a bishop.

ENTHUSIASM, n. *ĕn-thō'zī-ăzm* [Gr. *enthousias'mos*, divine transport or inspiration—from *en*, in; *thèōs*, a god: F. *enthousiasme*]: elevation of fancy; intense heat of imagination arising from belief in revelation; elevated and noble excitement in pursuit of some good; fanaticism; violent excitement of mind in the pursuit of some object; ardent zeal. ENTHU'SIAST, n. *-ăst*, one filled with mental excitement; one imagining himself possessed of some special revelation; a zealot; one who is ardent and imaginative. ENTHU'SIAS'TIC, a. *-ăs'tik*, ardent; zealous; visionary: also ENTHU'SIAS'TICAL, a. *-ăs'ti kăl*. ENTHU'SIAS'TICALLY, ad. *-lī*.—SYN. of ‘enthusiast’: fanatic; devotee; visionary; bigot.

ENTHYMEME, n. *ĕn'thī-mēm* [Gr. *enthumēmă*, a thought, a syllogism—from *en*; *thumos*, the soul, mind: F. *enthymème*]: in logic, an argument consisting of two propositions, an antecedent and a consequent; a syllogism where one premise is suppressed.

ENTICE, v. *ĕn-tīs'* [OF. *entiser*, and *enticer*: Bret. *atiza*, to instigate, to incite: Dut. *hissen*; Ger. *hetzen*, to set on dogs—the origin being the hissing sound by which dogs are incited to attack other animals]: to attract by exciting hope or desire; to allure; to tempt; to decoy; to lead astray. ENTI'CING, imp. *-sīng*: ADJ. alluring. ENTI'CINGLY, ad. *-lī*. ENTICED', pp. *-tīst'*. ENTI'CER, n. *-sér*, one who. ENTICE'MENT, n. *-tīs'mēnt*, that which allures; that which seduces or incites to evil.—SYN. of ‘entice’: to seduce; incite; coax; inveigle; persuade; attract; induce.

ENTIRE, a. *ĕn-tīr'* [F. *entier*; It. *intero*, whole, complete—from L. *int̄egrum*, whole, untouched]: undivided; unbroken; whole; complete in all its parts; without defect; uncastrated, as an entire horse; sincere; honest; wholly devoted; unmixed; in *OE.*, internal; interior. ENTIRE'LY, ad. *-lī*, in the whole; completely; in *OE.*, internally; in the heart. ENTIRE'NESS, n. *-nēs*, wholeness; completeness. ENTIRE'TY, n. *-tī*, the whole; completeness: the preceding words sometimes spelled with *i* in *OE.*—SYN. of ‘entire’: complete; total; integral; perfect; radical; undivided; full; undiminished; unalloyed; unmixed; pure; unmutilated.

ENTITLE, v. *ĕn-tī'tl* [F. *entituler*—from L. *int̄itūlārē*—from L. *en*; *titūlūs*, a title]: to name or designate; to give or prefix a name to; to qualify; to give a right to demand; to give a claim to. ENTI'TLING, imp. *-tī'tlīng*, designating; giving a claim to. ENTI'TLED, pp. *-tī'ld*, named; having a claim to.—SYN. of ‘entitle’: to designate; name; style; characterize; denominate.

ENTITY—ENTOMOLOGY.

ENTITY, n. *ěn'ti-ti* [F. *entité*—from mid. L. *entitatem*, entity—from L. *entem*, being]: being; existence; a real being. NONENTITY, n. [see the word]: a thing having no real existence.

ENTOBLAST, n. *ěn'to-bläst* [Gr. *entos*, within; *blastos*, a sprout, shoot, or sucker]: the nucleolus of a cell.

ENTOIL, v. *ěn-toyl'*: to take in a snare or toils; to insnare; to entrap.

ENTOMB, v. *ěn-tóm'* [*en*, in, and *tomb*]: OF. *entomber*, to entomb—from mid. L. *intumulare*]: to hide or conceal completely; to put or place in a tomb. ENTOMB'ING, imp. ENTOMBED', pp. *-tóm'd'*. ENTOMB'MENT, n. *-tóm'mént*, entire seclusion; burial.

ENTOMIC, a. *ěn-tóm'ik* [Gr. *entóma*, insects]: pertaining to insects. ENTOMOID, a. *ěn'tóm-oyd* [Gr. *eidos*, resemblance]: resembling an insect. ENTOMOMETER, n. *-to-móm'éter* [Gr. *metron*, a measure]: instrument for measuring the parts of insects.

ENTOMOLINE. see CHITINE.

ENTOMOLOGY, n. *ěn'tō-mól'ō-jí* [Gr. *entómā*, insects *logos*, discourse: F. *entomologie*: *entoma*—from Gr. *en*; *tomē*, a cutting]: that branch of natural science which treats of the history and habits of insects (q.v.). EN'TOMOL'OGIST, n. *-jist*, one who studies the habits, etc., of insects. EN'TOMOLOG'IC, a. *-lój'ik*, or EN'TOMOLOG'ICAL, a. *-i-kál*, pertaining to. EN'TOMOLOG'ICALLY, ad. *-lī*. ENTOM'OLITE, n. *-tóm'ō-lít* [Gr. *lithos*, a stone]: the general term for a fossil insect.—*Entomology* is important both philosophically and practically. The mere collector of insects may be one of the humblest laborers in the great field of natural history, but his labors contribute materials for the more philosophic naturalist who studies the structures of these creatures, and compares them with one another according to the unity and the variety of design which they exhibit. And when we begin to take into account the vast number of different species of insects, their great diversities of structure and of habits, their great complexity of organization, the wonderful transformations which many of them undergo at different stages of their existence, and the equally wonderful but extremely various instincts which many of them display, we find entomology to be a science worthy to engage the noblest mind. But besides all these things, we must remember that insects serve most important purposes in the general economy of nature; and that some of them are directly useful to man, some directly injurious, at least when their numbers are at any time excessively multiplied.

Entomology, with the other branches of natural history, was cultivated by Aristotle and other Greeks. Aristotle is the most ancient author of whose works anything relating to this science now remains. Pliny has little on this subject but what is copied from Aristotle; and it can scarcely be said to have been again studied as a science till the 16th c., when attention began once more to be directed to it, though it was not till the 17th c. that much progress

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was made, or that any important works on entomology appeared. Insects then began to be described, not only those of Europe, but also some of the curious and splendid insects of tropical countries; bees and other insects of particular interest received attention; the metamorphoses of insects began to be studied, and their anatomy to be investigated. The names of Goedart, Malpighi, Swammerdam, Leuwenhoek, and Ray, deserve to be particularly mentioned; but the infant state of the science may be illustrated by the fact, that about the end of the 17th c., Ray estimated the whole number of insects in the world at 10,000 species, a number smaller than is now known to exist in Britain alone. In the 18th c., the name of Linnæus occupies as high a place in the history of entomology as in that of kindred branches of science. The progress of the science was much promoted by his arrangement and exhibition of the discoveries of previous and contemporary naturalists; and by his system of classification, founded on characters taken from the wings, or their absence, a system professedly artificial, yet so harmonizing with the most natural distribution into groups, that some of its orders were indicated by Aristotle, and that it has retained and seems likely to retain its place, modified, indeed, but not essentially changed. De Geer and Fabricius are perhaps, after Linnæus, the most worthy to be named of the great entomologists of the 18th c. At the close of the 18th and beginning of the 19th c., the name of Latreille is pre-eminently conspicuous; and in 1815, a new impulse began to be given to the study of entomology in Britain by the publication of the admirable *Introduction to Entomology* of Messrs. Kirby and Spence, a work combining in a remarkable degree popular and scientific merits. Since the beginning of the 19th c., the number of insects known and described has prodigiously increased; many entomologists have with great advantage applied themselves particularly to the study of particular orders of insects; and many valuable monographs have appeared. Entomological literature has now become very extensive. The progress of the science has owed not a little to entomological societies, of which the Entomological Soc. of London may be particularly mentioned. Without an attempt to enumerate the distinguished entomologists of the 19th c., perhaps the names of Leach, Macleay, Curtis, Stephens, Westwood, Smith, Walker, Stainton, Swainson, Newport, Darwin, and Lubbock, deserve notice in Britain; Meigen, Jurine, Gyllenhal, Gravenhorst, Hubner, Dufour, Boisduval, Eichsen, Burmeister, Gerstäcker, on the Continent; in general entomology, in America, Say, Harris, Walsh, Fitch, Packard, Riley; in the study of special orders, Scudder, J. L. Leconte, Cresson, Uhler, Hagen, Grote, Lintner, Emerton, McCook, Edwards, etc.

ENTOMOPHAGOUS, a. *ěn'tō-mof'ă-gūs* [Gr. *entomā*, insects; *phagō*, I devour]: insect-eating—applied to animals which chiefly subsist on insects. EN'TOMOPH'AGA, n. plu. *mof'ă-gă*, the section of the marsupials which chiefly live

ENTOMOPHILOUS—ENTOPHYTE.

upon insects. ENTOMOPHAGAN, n. -*gǔn*, animal belonging to the entomophaga.

ENTOMOPHILOUS, a. *ěn'tō-mōf'i-lūs* [Gr. *entōmā*, insects; *phileō*, I love]: in bot., applied to flowers in which pollination or fertilization is effected by insects.

ENTOMOSTEGIDÆ, n. *ěn-tō-mo-stēj'i-dē* [Gr. *entomos*, cut in pieces; *stegē*, a roof; a covering]: family of *Rhizopoda*, consisting of animals with shells, the chambers arranged spirally in a double series.

ENTOMOSTOMATA, n. *ěn-to-mo-stōm'a-tā* [Gr. *entomos*, cut in; *stoma*, the mouth: named from the notched lip]: old division of mollusks, including *Buccinidæ*, etc.

ENTOMOSTRACA, n. *ěn'tō-mōs'trā-kū* [Gr. *entōma*, insects; *ostrākon*, shell]: order of minute crustacea. They have a developed cephalo-thorax; mandibles and 3 pairs of maxillæ; 5 pairs of thoracic feet, and no abdominal; and are destitute of gills. The sub orders are *Copepoda*, represented by Cyclops (q.v.) and other forms, known as water-fleas; and *Siphonostoma*, parasitic and worm-like. Formerly, E. included several other orders.

ENTOMOTOMIST, n. *ěn-to-mōt'o-mist* [Gr. *temnō*, I cut]: one who anatomizes insects; one who practices entomotomy. ENTOMOT'OMY, n. -*mī*, the dissection of insects, and the science which treats of their anatomy.

ENTONIC, a. *ěn-tōn'ik* [see ENTASIS]: in med., having great tension or exaggerated action.

ENTOPERIPHERAL, a. *ěn-tō-pēr-if'er-äl* [Gr. *entos*, within; Eng. *peripheral*]: term introduced by Herbert Spencer to designate sensations, feelings, etc., produced by causes operating within the periphery, circumference, or outer surface of the body, as the sensations of hunger, thirst, etc. It is opposed to epiperipheral.

ENTOPHYTE, n. *ěn'tō-fit*, EN'TOPHYTES, -*fitz*, or EN'TOPHYTA, n. plu. *ěn-tif'i-tū* [Gr. *entos*, within; *phuton*, a plant]: vegetable parasites which exist within living bodies, found in some diseases of the mucous membranes of the mouth and alimentary canal; plants growing within others: ENTOPHYTIC, a. *ěn'tō-fit'ik*, developing in the interior of plants and afterwards appearing on the surface, as fungi. —*Entophytes* denotes usually those parasitic plants which grow on living animals. It is seldom extended to vegetable parasites which grow on living vegetables, whether on external or internal parts, nor is it restricted to those found in the internal cavities, or within the substance of animal bodies, but includes all which have their seat on living animal tissues. It does not, like the analogous term *Entozoa*, denote any particular class of organized beings; some of the entophytes are *Algae*, and some *Fungi*, but to these two series they are limited, and all belong to the lower section of these series, some to those lowest sections in which the distinguishing characters of the two series cannot easily be traced, so that they are referred to the one or the other on very slender grounds; those in which a coloring matter is

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present being reckoned algæ, though it can be observed only in masses of aggregated cells, and not in the cells when viewed separately, and those which even in the mass appear entirely colorless, being considered fungi. Many of the algæ and fungi parasitic on plants are nearly allied to those on animals; thus, ergot and the kind of mildew which has proved so destructive to vines, are referred to the same genus (*Oidium*) to which is referred also the fungus found in the diseased mucous membrane in cases of *aphthæ* or *thrush*: and another genus (*Botrytis*, q.v.) contains the fungus called Muscardine, or Silkworm Rot, so destructive to silkworms, together with the fungus which accompanies or causes the potato disease, and many other species which infest plants. Common mould is even supposed to occur on animal tissues tending to decay, during life, as well as on dead animal and vegetable substances.

Vegetable parasites occur both in man and in the lower animals; not a few are peculiar to fishes, and more are peculiar to insects than to any other class of animals. The fungi which grow on the bodies of insects sometimes attain extraordinary development: *Sphaeria Sinensis*, which grows on a Chinese caterpillar, and to which medicinal virtues, probably imaginary, are ascribed in China, attains a length greater than that of the caterpillar itself. A similar species (*S. Robertsii*) is found on the caterpillar of a New Zealand moth.

The situations in which entophytes occur are very various. Some, like the thrush fungus already noticed, appear in diseased conditions of the mucous membrane; some find their place in the lungs, the ear, or other organs; some on the skin, in the hair follicles, and *in* as well as *on* the hair itself. The 'fur' which appears on the tongue when the stomach is disordered, abounds in the extremely slender unbranching threads of the alga called *Leptothrix buccalis*, which also vegetates luxuriantly in cavities and corners of the teeth not sufficiently visited by the tooth-brush. The lungs of birds, the gills of fishes, the intestines of insects, the wing-covers of beetles, the eggs of mollusks, all have their peculiar vegetable parasites by which they are sometimes infested.

It is often difficult to say whether the presence of entophytes is to be regarded as the consequence or as the cause of disease; sometimes it may be both. Sometimes it appears to be certainly a consequence, as when the *Sarcina* (or *Merismopædia*) *ventriculi* occurs in the contents of the stomach and bowels; sometimes, as in the diseases called *Favus*, *Porrigo*, *Tinea*, *Herpes tonsurans*, *Plica Polonica*, *Mentagra*, *Pityriasis versicolor*, etc., it seems entitled to be regarded as the cause of the diseased state, and the cure of the disease seems to be accomplished by killing the parasite, often a difficult work.

Whence the germs of entophytes are derived is often doubtful. Their spores are extremely minute; but there are no plants which produce seeds or spores more abundantly than some of them do; the growth of the plants them-

ENTOPTERYGOID—ENTOURED.

selves is very rapid, and reproduction is ‘very intense and rapid.’

The relation of entophytes to certain forms of disease has become a subject of the greatest interest and importance in medical science in recent years. For full treatment of this subject see BACTERIA and GERM THEORY. See also: PARASITES: PARASITIC DISEASES: FUNGI: FERMENTATION.

ENTOPTERYGOID, n. *ĕn-tō-tĕr'ĭ-goyd* [Gr. *entos*, within; Eng. *pterygoid*]: oblong, thin, scale-like bone attached to the inner border of the co-adapted halves of the palative and true pterygoid in fishes, and increasing the bony roof of the mouth in the direction toward the median line.

ENTOPTIC, a. *ĕn-tōp'tik* [Gr. *entos*, within; *eptomai*, to see]: pertaining or relating to visions seen by the eye when the lids are shut.

ENTOSTHOBLAST, n. *ĕn-tōs'tho-blăst* [Gr. *entosthe*, from within; *blastos*, a sprout, shoot, or sucker]: nucleus of the nucleolus or entoblast.

ENTOURED, a. *ĕn-tōr'd'* [F. *entouré*]: in her., term applied to a shield decorated with branches.

ENTOZOOON.

ENTOZOOON, n. *ěn'tō-zō'ōn*, EN'TOZO'A, n. plu. -ă [Gr. *entos*, within; *zōōn*, an animal]: an animal which lives within the bodies of other animals—properly applied to those infesting the intestines. EN'TOZOIC, a. -ik, relating to or connected with the ENTOZOOA. EN'TOZOOL'OGIST, n. -zō-ōl'ō-jist [Gr. *logos*, a discourse]: one who investigates the habits and characters of internal parasites.

Entozoa is a term applied to all the animal forms which live either in the natural cavities (for example, the intestinal canal), or in the solid tissues (for example, the liver) of other animals. The number of these parasites is so great (there being at least 20 distinct species of worms found in man, 14 in the dog, 15 in the horse, 11 in the common fowl, etc.), and their occurrence so frequent, especially in some of the lower animals, that we must regard their presence, at all events in many species, rather as the normal condition, than as a morbid state due to accidental causes.

It is worthy of notice, that many of the animals included among the entozoa have a parasitic existence during only a part of their total life, which often, as in the well-known case of perfect insects, presents very varied and distinct phases. Thus, for example, the larvæ of the gadfly (*Estrus equi*) undergo their entire development in the stomach of the horse, attaching themselves by minute hooks to the gastric mucous membrane; they then detach themselves, pass along the intestines, and in due time are discharged, and undergo their further changes externally; and many similar instances might be quoted. For this reason, and additionally because parasites are now known to belong to various classes of animals, we no longer attempt, like Linnæus and Cuvier, to form a special group of E.; and a reference to the *Vermes intestinæ* in the *Systema Naturæ*, or to the *Entozoaires* in the *Règne Animal*, at once shows that these illustrious naturalists grouped together animals with few or no true natural affinities.

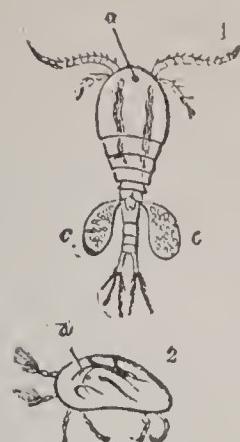
Entozoa belong largely but not exclusively to the class of *Vermes*, or *Worms*. Thus, even fishes may lead a parasitic existence; a fish of the genus *Fierasfer* being often found in the respiratory cavity of the *Holothuria tubulosa*, or *Sea-cucumber*, and small fishes being frequently observed in the cavity of the *Asteria discoïdes*. Among the crustaceans, instances of parasitism are not rare; different species of *Lernæa* being abundant in the branchial (or gill) cavity, and on the surface of numerous fishes, while the *Linguatulæ* infest mammals, reptiles, and fishes, being found in the olfactory of the sinuses, the larynx, the lungs, the peritoneal cavity, etc. The instances in which mollusks are found to live parasitically are few; certain gasteropods, however, inhabit the bodies of echinoderms, holothurias, and comatulas; and among the lamellibranchiates, species of modiolaria and mytilus live in the bodies of ascidians. There are several cases of polyps observed to adopt a parasitic existence; finally, various protozoa are frequently found in the animal fluids; for example, certain species of *Vibrio*, *Cercomonas*, and *Paramecium*, have been found

PLATE 22.

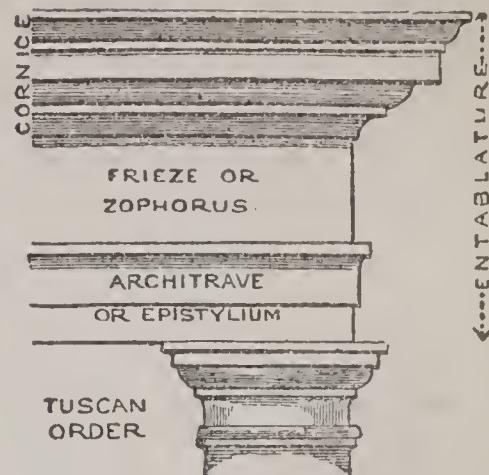
Ensiform
Entresol



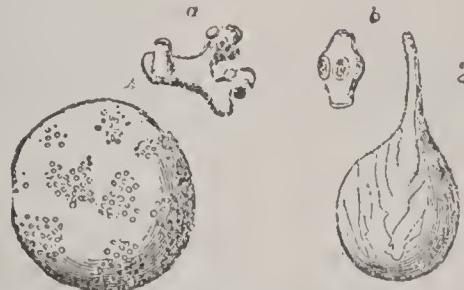
Entasis.



Entomostraæ.—1,
Cyclops quadricornis:
a, Eye; c, c, Eggs. 2,
Cypris: a, Eye.



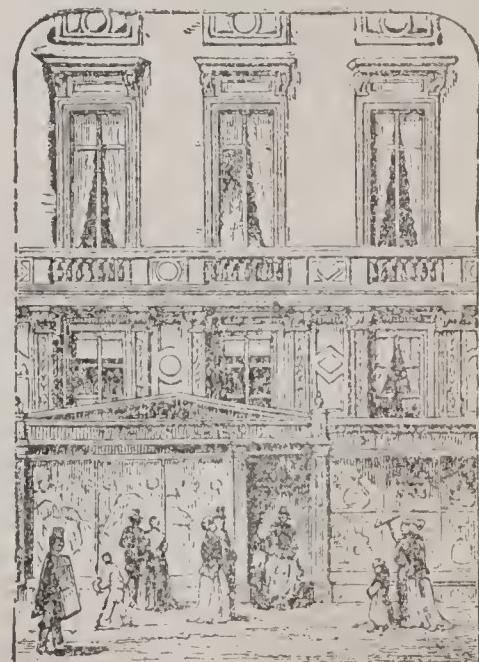
Entablature.



Entozoa magnified.—1, *Coccyurus cerebralis* (producing the staggers in sheep): a, Heads (shown on the surface) separately. 2, *Cysticercus cellulosæ* (causing the measles in pigs): b, Head.



Ensiform,—Leaf of Iris.



Entresol or Mezzanine, Regent Circus, London.

ENTOZOOON.

In the intestinal evacuations in cholera and diarrhoea; *Monads* in the urine in cholera, and certain infusoria and rhizopoda in the blood of the dog, the frog, and many other animals. See HÆMATOZOA.

The more common kinds of entozoa appear to have attracted the notice of the earliest physicians and naturalists whose opinions or works have reached us. Hippocrates speaks of several worms, especially tæniæ and ascarides, infesting the human intestinal canal; and Pythagoras learned in India that the bark of the pomegranate acted almost as a specific in cases of tape-worm. Aristotle noticed the tapeworm both of the dog and of man, and the *Cysticercus cellulosæ* (see CESTOID WORMS, under CESTOID) of the pig; but, utterly unaware that the cysticercus, under favorable conditions, became developed into a tape-worm (see TAPE-WORM), referred the origin of all intestinal worms to spontaneous generation—a doctrine that seems to have been general till the 17th c., when Redi published (1684) a work on Helminthology, in which he distinctly showed that the generation of various entozoa followed the same laws as in higher animals, and that in many instances there were distinct males and females. For the great recent discovery, that the vesicular or bladder-like parasites, such as the different species of cysticercus and cœnurus, are cestoid worms in an early stage of development (alluded to in CESTOID WORMS), see TAPE-WORM.

Another point of general interest in connection with E., is the part of the body in which they are found. While most live in the intestinal canal and other open cavities as (the larynx, bronchial tubes, etc.), others are found in the closed cavities, and in the parenchymatous tissue of the liver and other solid organs. Thus (noting only the E. occurring in man), *Anchylostoma duodenale*, *Strongylus duodenalis*, two species of *Ascaris*, *Oxyuris vermicularis*, *Trichcephalus dispar*, *Distoma heterophyes*, at least four species of *Tænia* and *Bothriocephalus latus*, have been found in different parts of the intestinal canal; while *Strongylus gigas* inhabits the kidney, another species of *Strongylus* the lungs, a species of *Spiroptera* the bladder, two species of *Filaria* and *Monostoma Lentis* the eye, *Trichina spiralis* the voluntary muscles, two species of *Echinococcus* and *Cysticercus cellulosæ*, various parenchymatous tissues, two species of *Distoma* the gall-bladder; another species the portal vein, and the *Filaria Medinensis*, or guinea-worm, the subcutaneous tissue.

Davaine, who may be regarded as one of the very highest authorities on this subject, gives the following synopsis of the entozoa occurring in man and the domestic animals (see his *Traité des Entozoaires*, Paris 1860).

TYPE I. PROTOZOA, including the genera *Bacterium*, *Vibrio*, *Monas*, *Cercomonas*, *Trichomonas*, *Paramecium*.

TYPE II. CESTOIDEA, including the families of *Tæniidae* and *Bothriocephalidae*. The *Tæniidae* occur (1) in their undeveloped, cystic, or vesicular form, constituting the genera *Cœnurus* and *Cysticercus*; and (2) in their perfect, ribbon-like shape, constituting the genus *Tænia*, of which about 20 species have been described. The *Bothriocephalidae*

ENTR'ACT—ENTRAILS.

contain the single genus *Bothriocephalus*, which embraces various species. Their early or vesicular stage has not yet been described.

TYPE III. TREMATODEA, including two well-marked secondary types: (1) The *Polystomidae*, which lives as epizoa on the skin or gills of aquatic animals, and which do not concern us here; and (2) the *Distomidae*, including the genera *Monostoma*, *Distoma*, *Holostoma*, *Amphistoma*, with the doubtful genera of *Tetrastoma* and *Hexathrydium*.

TYPE IV. ACANTHOCEPHALA, with the single genus *Echinorhynchus*.

TYPE V. NEMATOIDEA. Passing over two cases in which these worms have been discovered, apparently in their larval or imperfectly developed state (once by Rainey in the human trachea, and once by Vulpian in the kidney of the dog), Davaine gives the following genera, *Oxyuris*, *Ascaris*, *Spiroptera*, *Trichina*, *Trichosoma*, *Trichocephalus*, *Filaria*, *Dochmias*, *Sclerostoma*, *Strongylus*, *Anchyloetoma*, *Dactylius*.

TYPE VI. ACANTHOTHECA, including the genus *Pentastoma*.

Alarming as the above list may seem, comparatively few of the worms contained in it do in reality give rise to dangerous or severe symptoms. It seems to be a condition of parasitism, that the animal upon which the parasite lives must not be destroyed by it; and it has been suggested by one of our highest authorities on this subject, Van Beneden, that in many cases the parasite does not so much attack the organism in which it exists, as its superabundant products. Dujardin and other helminthologists have described cases in which worms were developod by thousands in persons apparently in good health. For the symptoms occasioned by *Ascarides*, *Tæniæ*, etc., see ASCARIS: TAPE-WORM: etc.

The multiplication of worms is most rapid in debilitated persons, especially children living in cold and damp situations; and impure water, unripe fruits, and raw or imperfectly cooked meat, have considerable influence on the development of these animals. For description of the medicines used for their destruction, see VERMIFUGES: for the structure and habits of the most important E., see ASCARIS: BOTHRIOCEPHALUS: CESTOID WORMS: GUINEA-WORM: MONOSTOMA: NEMATOIDEA: STRONGYLUS: TAPE-WORM: THREAD-WORMS: TREMATODA: TRICHINA SPIRALIS: TRICHOCEPHALUS.

ENTR'ACT, *äng-träkt*, in Music: instrumental piece, composed in the form of a little symphony or overture, to be performed between the acts of a play.

ENTRAIL, v. *ën träl* [F. *en*, in; *treille*, a walk covered with vines, a trellis-arbor]: in *OE.*, to interweave. ENTRAIL'ING, imp. ENTRAILED, pp. *ën-träl'd*, interwoven.

ENTRAILS, n. plu. *ën'träls* [F. *entrailles*, bowels—from mid. L. *intrāliū* for *intrānēū*, the bowels—from L. *inter*, within: Gr. *entēra*, plu. of *entēron*, a piece of the guts]:

ENTRAMMEL—ENTRÉ DOURO E MINHO.

the bowels; internal parts of animals; internal parts: sing. ENTRAIL.

ENTRAMMEL, v. *ĕn-trăm'ĕl* [*en*, and *trammel*, which see]: to trammel; to entangle.

ENTRANCE, n. *ĕn'trăns* [L. *intrans*, entering in (see ENTER)]: act of entering; a door, gateway, or passage; beginning or commencement; the act of taking possession and power of.

ENTRANCE, v. *ĕn-trăns'* [*en*, in, and *trance*]: to put in a trance; to make insensible to present objects; to ravish with delight or wonder. ENTRAN'CING, imp.: ADJ. enrapturing; ravishing. ENTRANCED', pp. *-trănst'*, enraptured; carried away with delight. ENTRANCE'MENT, n. a state of ecstasy.

ENTRANT, n. *ĕn'trănt* [see ENTER]: one who enters, or has entered; an applicant for admission.

ENTRAP, v. *ĕn-trăp'* [*en*, and *trap*]: to insnare; to inveigle; to catch as in a trap; to entangle. ENTRAP'PING, imp. ENTRAPPED', pp. *-trăpt'*.—SYN. of 'entrap': to decoy; implicate; catch; involve.

ENTREAT, v. *ĕn-trēt'* [F. *en*, in: OF. *traicter* and *traieter*, to meddle with; to discourse—from L. *tractārē*, to handle]: to solicit pressingly; to ask earnestly; to beseech; to importune; to prevail on; to deal with; to use; in *OE.*, to amuse; to entertain; to petition for. ENTREAT'ING, imp. ENTREAT'ED, pp. ENTREAT'INGLY, ad. *-lī*. ENTREAT'ER, n. one who. ENTREAT'Y, n. *-i*, urgent prayer; earnest petition; pressing solicitation.—SYN. of 'entreat': to ask; beg; implore; crave; solicit; supplicate; petition; persuade; —of 'entreaty': importunity; supplication; suit; request; solicitation.

ENTRE DEUX, ad. n. *āng'tr dū* [F. *entre*, between; *deux*, two]: so so; indifferently; crochet-insertion, a kind of ornamental work suitable for the dresses of children. ENTRE NOUS, *āng'tr nō* [F. *nous*, us]: between you and me; in confidence.

ENTRÉ DOURO E MINHO, *ĕn'tră dō'rō ā mēn'yō* (frequently MINHO): province of Portugal, in the extreme n.w. of the country; bounded n. by Galicia, from which it is separated by the river Minho; on the e. by Galicia and Tras os Montes; on the s. by the province of Beira, from which it is separated by the river Douro; and on the w. by the Atlantic Ocean; about 2,810 sq. m. It has been called the Paradise of Portugal, and indeed it may be doubted whether any territory in Europe of equal extent exhibits so much beauty. It is traversed from n.e. to s.w. by three mountain-ranges, which, however, sink down as they approach the coast, leaving a considerable undulating tract along the sea-margin. The chief rivers, besides the boundary rivers already mentioned, are the Lima—a portion of the vale of which is said to form the loveliest landscape in the world—the Cavado, and the Tamego. The climate is agreeable and healthful. The chief productions

ENTRÉE--ENTROPY.

are wine, oil, flax, maize, wheat, barley, oats, and vegetables. Wine, shipped at Oporto, is largely exported. Along the coast are numerous fisheries, at which great numbers find employment. The province of Minho consists of three districts, Braga, Vianna, and Porto.—Pop (1870) 982,735; (1881) 1,014,768; (1900) 1,173,106.

ENTREE, n. *āng' trā* [F. *entrée*—from *entrer*, to enter]: access; entry; course of dishes at table. ENTRÉES, n. plu. *āng' trāz*, side dishes; not the principal dishes; shortened form of *entremets*. EN'TREMETS, n. -*tr-mā* [F. a dish between—from *mets*, a dish]: side dishes; dishes containing dainties not the principal ones: it has become customary to apply the name *entremets* to the lighter of these dishes. EN'TREPÔT, n. -*tr-pō* [F.—from L. *interpōsum*, to place between]: a warehouse in which goods may be stored; a storehouse. ENTRESOL, n. *āng' tr-sōl* [F. *entre*, and *sol*, the ground plot or floor]: in *arch.*, a low story between two main stories of a building (generally between the ground floor and the first story), or between two portions of one story, when certain rooms are of greater height than the others upon the same floor. The rooms in the entresol are called *Entresols* or *Mezzanines*.

ENTRENCH, v.: same as INTRENCH, which see.

ENTRE RIOS, *ēn' trā rē'ōs* (Spanish for *Between Rivers*): one of the states of the Argentine Confederation; named from its situation between the Paraná and the Uruguay; 40,000 to 45,000 sq. m. The country is almost entirely pastoral—its principal production being hides, horns, tallow, and jerked beef. The soil is not well fitted for cultivation, for, besides being rather swampy throughout, it is subject, in the south, to annual floods. The cap. is Paraná (pop. 15,000). Pop. of E. (1889) 300,000; (1900) 343,684.

ENTROCHITES, n. plu. *ēn'trō-kīts* [Gr. *en*, in or on; *trochos*, a wheel]: a name given to the wheel-like joints of the encrinite; also called EN'TROCHI, n. plu. -*kī*, and EN'TROCHITÆ, n. plu. *ēn'trō-kītē*.

ENTROPIUM, n. *ēn-trō'pī-ūm*, or ENTROPION [Gr. *en*, in; *tropē*, a turning]: in *med.*, the inversion or turning in of the eyelashes, or even of the eyelid, consequent either on loss of substance, or on inflammatory swelling of the lid. If confined to one or two eyelashes, they should be plucked out by the roots, and the bulbs should be cauterized; but the radical cure of severe E. requires careful adaptation of the surgeon's art to the particular case, and should not be attempted by unskilled hands. ENTROPY, n. *ēn'trō-pī*, the available energy of a system, or that which can be converted into mechanical work.

ENTROPY, *ēn' trō-pī*: term denoting the available energy of a system, originated with Clausius, great mathematical physicist. He applied it to a mathematical expression, but it is now used in a more general though practically identical sense. By the doctrine of the conservation of energy (see FORCE), the total energy of the universe is constant. But the power of doing work within the limits of the universe is

ENTRUST—ENUCLEATE.

not constant. This power depends on differences in energy possessed by different masses. A steam-engine does work by converting into motion against resistance a certain portion of the heat energy produced by the burning coal. The water in the boiler being of lower temperature, or at a lower pitch of energy, than the products of combustion, flames, etc., of the coal, can absorb energy from those, and rise to a higher pitch. Then in descending nearly to its former pitch it does work. Hence for work to be done energy must leave some mass in order to develop other energy elsewhere, the latter being the effect of work done. But if all matter possessed exactly the same intensity or quality of energy, there could be no interchange. Broadly, the available energy or E. of the universe is due to the existence of, or possibility of developing, differences of temperature. When all the coal becomes exhausted one great source of E. will disappear. As all other causes of difference of energy are disappearing as well as the fuel supply, the E. or available energy of the universe tends toward zero. When it will have reached that point, all objects will have the same temperature and all possible chemical reactions will have been accomplished. If the natural order remains undisturbed, such a condition might be reached many thousands of years from the present time. During many centuries to come, the E. will be practically undiminished.

ENTRUST: same as INTRUST, which see.

ENTRY, n. *ěn'trī* [F. *entrée*, act of coming in (see ENTER)]: the passage by which persons enter a house or building; ingress; the exhibition of a ship's papers to the custom-house authorities in order to obtain permission to land the goods; the actual taking possession of lands or tenements; the act of recording in a book. **SINGLE ENTRY**, in *book-keeping*, the posting or entry of the items only once—under the buyer's name. **DOUBLE ENTRY**, the posting or entry of every item twice, under changed conditions—once on the Dr. side and once on the Cr. side, keeping both personal and real accounts. **RIGHT OF ENTRY**, in *law*, right of one who has been wrongfully dispossessed or ousted of land and tenements by Abatement, Intrusion (see these titles), or Disseizin (see Disseize). A right of entry (formerly lost by suffering a descent cast, i.e., where the tenant tortiously in possession is permitted to continue unmolested till his death, and is succeeded by his heir) is now lost in some places by not asserting it for 20 years. **ENTRY OF AN HEIR**, in the *feudal law of Scotland*, the recognition of the heir of a vassal by the superior or dominus: sec CONVEYANCING.

ENTUNE, v. *ěn-tūn'* [F. *entouner*; Sp. *entanar*; It. *intonare*]: to tune; to sing; to chant.

ENTWINE, v. *ěn-twīn'* [*en*, *twine*]: to twist round. **ENTWINING**, imp. **ENTWINED'**, pp. *-twin'd'*. **ENTWIMENT**, n. a twining or twisting round. **ENTWIST'**, v. *-twist'*, to twist or wreath together.

ENUCLEATE, v. *ě-nū'klē-āt* [L. *enuclēātus*, cleared from the husk, pure—from *e*, out of; *nucleus*, a nut]: to

ENUMERATE—ENVELOP.

clear; to disentangle; to solve. ENU'CLEATING, imp. -ā-tīng.
ENU'CLEATED, pp. -ā-tēd.

ENUMERATE, v. ē-nū'mē-rāt [L. *enumératus*, reckoned up, enumerated—from *e*, out of; *numérō*, I number: It. *enumerare*: F. *énumérer*]: to reckon up or tell the number of singly; to count or mention a number of things one by one. ENU'MERATING, imp. ENU'MERATED, pp. ENU'MERA'TION, n. -ā'shūn [F.—L.]: counting up a number of things by naming each particular one. ENU'MERATIVE, a. -tīv, counting singly. ENU'MERA'TOR, n. -térl, one who.

ENUNCIATE, v. ē-nū'n'sī-āt or -shī-āt [L. *enunciātus*, divulged, disclosed—from *e*, out of; *nunciō*, I tell: It. *enunciare*: F. *énoncer*]: to declare; to utter; to proclaim. ENUN'CIATING, imp. ENUN'CIATED, pp. ENUN'CIA'TION, a. -ā'shūn, the act or manner of uttering; manner of pronunciation; declaration; in *geom.*, the words in which a proposition is stated. ENUN'CIATIVE, a. -tīv, expressive; declarative. ENUN'CIA'TIVELY, ad. -lī. ENUN'CIA'TOR, n. -ā'tér, one who enunciates or declares. ENUN'CIA'TORY, a. -ā'tér-ī, containing utterance or sound.

ENURE, v. ēn-ūr' [see INURE]: to habituate; in *law*, to come into use or power.

ENURESIS, n. ēn'ū-rē'sīs [Gr. *enourēō*, I make water—from *en*, in; *ouron*, urine]: incontinence or involuntary escape of the urine.

ENURNY, a. ēn-ēr'nī [etym. doubtful]: in *her.*, term applied to a border charged with eight animals of any kind.

ENVELOP, v. ēn-vēl'ōp [OF. *envoluper*; F. *envelopper*, to wrap round, to fold up: It. *inviluppare*]: to cover by folding; to inclose by wrapping; to surround entirely; to hide. ENVEL'OPING, imp. ENVEL'OPED, pp. -ōpt. ENVEL'OPMENT, n. a covering on all sides. ENVELOPE, n. ēn'vēl-ōp, an inclosing cover; a wrapper; a kind of flat paper bag or case for sending letters in; any investing integument.—Until the introduction of cheap and pre-paid postage, envelopes for written letters were little used; it was customary to secure, by wafer or sealing-wax, the folded sheet of paper on which the letter was written. Envelopes have now come into universal use—both those stamped and sold by government, and those unstamped made by private manufacturers. Envelopes are made by two methods, involving different amounts of machine-power. The paper is first cut into quadrangular pieces rather longer than wide, by a cutting blade brought to bear upon a pile of sheets at once; and then cutting-dies reduce these pieces to the proper shape, generally lozenge or diamond form, but sometimes with curvilinear edges. For some kinds, it is found to economize both time and paper to stamp the pieces out at once from the rough sheets. The subsequent folding and gumming are performed sometimes by hand, sometimes by machine. In the hand-method, women and girls fold with almost incredible quickness, having very simple guide-pieces to aid them in giving the proper oblong quadrangular

ENVENOM—ENVOY.

shape to the fold. The gum is applied with a small brush, either all along the overlapping edges, or in spots here and there, according to the quality of the envelope.

The envelope-machines are beautiful examples of automatic mechanism. In one well-known kind, a cutting-machine severs the blanks or papers; and dies are employed to stamp the device on the spot where the seal would otherwise lie. The blanks are then 'fed' into the folding-machine, where they pass through a curious series of processes. Each blank is carried down into a box, where a plunger makes four creases in it; two short levers fold down two of the flaps thus made; a gumming apparatus comes up, and applies a line of wet gum to each flap-edge; two small levers then fold down the other two flaps (but fastening only one of them); finally, the envelope is shifted aside to a pile, and makes way for another. All these processes are gone through in *one second*, enabling the machine to make 60 envelopes per minute. Where twelve of these machines are working at once, it will be seen that a million envelopes are put out of hand in a very short time.

ENVENOM, v. *ĕn-vĕn'ōm* [*en*, and *venom*; OF. *envenimer*, to envenom]: to taint or impregnate with poison or with malice, etc.; to enrage; to make odious. **ENVEN'OMING**, imp. **ENVEN'OMED**, pp. *-ōmd*, tainted with poison.

ENVIABLE, **ENVIER**, **ENVIOUS**, etc.: see under **ENVY**.

ENVIRON, v. *ĕn-vi'rōn* [F. *environ*, about, around; *environner*, to environ—from *en*, in; *virer*, to veer, to turn round]: to surround or encompass; to encircle or hem in. **ENVI'RONING**, imp. **ENVI'RONED**, pp. *-rōnd*. **ENVI'ROND**, n. act of surrounding; that which surrounds. **ENVIRONS**, n. plu. *ĕn-vi'rōnz* or *ĕn-vi'rōnz*, the parts lying near to or adjacent; the suburbs of a town or city.

ENVOY, n. *ĕn'voy* [F. *envoyer*, to send; *envoy*, a message—from *en*, in; L. *vīū*, a way]: diplomatic minister of the second order at a court, in dignity below an ambassador; a messenger sent by a state or government to negotiate a treaty with a foreign government; one sent on a special mission. **EN'VOYSHIP**, n. the office of an envoy.—Envoy ordinary and extraordinary, ministers plenipotentiary, the internuncios of the pope, and all other inferior diplomatic ministers, differ from ambassadors in this, that though they receive their credentials, like ambassadors, immediately from their sovereign or personal head of their govt., they represent not his personal dignity, but only his affairs of government. They stand to him as an ordinary agent to his principal, and their acts or promises are his in a business sense, though not in a personal sense. It is said that this class of diplomatists was introduced by Louis XI. of France, toward the end of the 15th c. The envoy is superior in rank to the chargé d'affaires whose credentials proceed from the ministers of the state from which he is sent, and are addressed to the ministers of the state to which he is sent; or are a mere delegation from an ambassador or envoy to

ENVY—EOCENE.

conduct the affairs of the mission in his absence. Consuls (q.v.) are not generally reckoned among diplomatic ministers, though, where they have diplomatic duties to perform independently of an ambassador or envoy, they are accredited, and treated as ministers. According to the division of diplomatic agents into four classes, which was made by the great powers at the congress of Vienna, 1815—viz. 1. Ambassadors, legates, and nuncios; 2. Envoys, ministers, and other agents accredited to sovereigns; and 3. Chargés d'affaires, accredited by and to the departments of Foreign Affairs—an envoy would be of the second, and a chargé d'affaires of the third rank. But the practice of some countries has interjected between the ambassador and the envoy a second class, called envoys extraordinary and ministers plenipotentiary, which, of course, throws the ordinary envoy into the third, and the chargé d'affaires into the fourth class. See CHARGÉ D'AFFAIRES: AMBASSADOR: EMBASSY: CONSUL: DIPLOMACY: MINISTER (in Diplomacy).

ENVY, *ěn'vī* [F. *envier*, to grudge; *envie*, envy—from L. *invīdiā*, envy, grudge—from *in*, in; *vīdēō*, I look]: to feel uneasy or mortified at another's superiority; to dislike and be discontented on account of the superior excellence or success of another; to look upon with malice: N. hatred or ill-will excited by the superior success or excellence of another; malice; an object of pain and mortification to others from superior success. EN'VYING, imp.: N. ill-will or mortification on account of some supposed superiority in others. EN'VIED, pp. *-vid*. EN'VIER, n. *-ér*, one who. EN'VIABLE, a. *-ă-bl*, capable of exciting desire to possess; desirable. EN'VIABLY, ad. *-bli*. EN'VIOUS, a. *-vī-ūs*, feeling uneasiness at the superiority or happiness of another. EN'VIOUSLY, ad. *-lī*. EN'VIOUSNESS, n. the quality or state of being envious.—SYN. of ‘envious’: invidious; jealous; suspicious; covetous; grudging.

ENWALLOWED, a. *ěn-wōl'lōd* [*en*, *wallow*]: in *OE.*, sunk, as among mud or mire; wallowed.

ENWHEEL, v. *ěn-hwēl'* [*en*, *wheel*]: in *OE.*, to encircle; to encompass.

ENWIND, v. *ěn-wīnd'* [*en*, *wind*]: to wind round; to encircle. ENWOUND, pp. *ěn-wownd'*, encircled.

ENWOMB, v. *ěn-wōm'* [*en*, *womb*]: to make pregnant; to hide or bury, as in a tomb.

ENWRAP, v. *ěn-răp'*: see INWRAP.

ENWREATHE: see INWREATHE.

ENYED': see NAGY-ENYED.

ENZINA, JUAN DEL: see ENCINA.

ENZOOTIC, a. *ěn'zō-ōt'ik* [Gr. *en*, in; *zōōn*, an animal]: applied to diseases among the lower animals peculiar to a district.

EOCENE, a. *ěō-sēn* [Gr. *ěōs*, daybreak, the dawn; *kainos*, recent, or new]: in *geol.*, the Lower Tertiary strata, so called because of the very small percentage (3½ per cent.) of existing mollusca contained in them, indicating the dawn of

EOCENE.

the present condition of creation. The term was introduced by Lyell. The gradual approximation of the living inhabitants of the globe to the present forms is the chief characteristic of the Eocene and newer deposits. The Eocene beds rest on the chalk. Like the other Tertiary strata, these deposits occupy small and detached areas when compared with the older measures. It is not difficult to determine the relative position of Primary or Secondary strata, because of the great extent of particular beds, being frequently continuous over extensive districts. But Tertiary deposits are more isolated, and occur in smaller and more detached patches; hence it is difficult to determine the contemporaneity of the sections of the various periods. Their relations must be determined from the petrological structure of the beds, which is very inconstant; or from the more satisfactory evidence derived from their fossiliferous contents.

In the following table are given the generally received divisions of this period, with the maximum thickness (in English ft.) of the English strata, and the French and Belgian equivalent beds:

MIDDLE EOCENE.	{ 1. Hampstead series, 2. Beombridge series, 3. Osborne series, 4. Headon series, 5. Bagshot series, 6. London clay series, 7. Plastic clay series, 8. Thanet sand series,	175	Calcaire lacustre supérieur, and Grès de Fontainebleau. —Rupelian.
		115	Gypseous series of Montmartre, Calcaire lacustre moyenne, and Calcaire siliceux.— Tongrien.
		70	Grès des Beauchamp.
		182	Sables moyennes, Calcaire grossier, and Lits coquille lières. — Laeckenien and Bruxellien.
		1270	Wanting in France.—Ypresien.
		480	Argile plastique et lignite.— Landenien supérieur.
		160	Wanting in France.—Landenien inférieur.
		90	
Total Thickness,		2,542 feet.	

In the United States the Lower, Middle, and Upper E. formations are known as the Claiborne, Jackson, and Vicksburg epochs, and the beds contain numerous marine mollusk fossils and some very large vertebrates. The beds extend from N. J. along a great portion of the s.e. coast, along the Gulf of Mexico, and up the Mississippi river; and the best developed formations are found in Md., Va., N. C., S.C., Miss., and Ala.. though the beds in Vt. exhibit leaves and fruits, and those in Wyo. the group of mammals called by Prof. Marsh *Dinocerata*. The Lower E. beds near Claiborne, Ala., have a total thickness of 125 ft.; the Middle E. at Jackson, Miss., contain marine shells and remains of mammoth whales, and stretch across the state like a belt, narrow but abt. 80 ft. thick; and the Upper E. have a total thickness at Vicksburg, Miss., of 112 ft., and extend into Ala., Fla., and S. C., exhibiting both limestone and gray marl. Up to 1888 no distinct E. beds have been discovered on the w. coast of the United States.

EOHIPPUS—EON DE BEAUMONT.

EOHIPPUS, n. *ē-ō-hī'p'pūs* [Gr. *ēōs*, the dawn; *hippos*, a horse]: in *paleon.*, genus of *Equidae*, oldest known member of the horse family. The animals were of small size, had on the fore feet four toes with a rudimentary thumb, and on the hind ones three toes, all the digits terminating in hoofs. It was found by Marsh in the Lower Eocene of New Mexico.

EOHYUS, n. *ē-ō-hī'ūs* [Gr. *ēōs*, the dawn; *huos*, a pig, a swine]: in *paleon.*, oldest known of the *Suidae* (Pigs); from the Lower Eocene of N. America.

EOLIAN, or ÆOLIAN, a. *ē-ō'lī-ān* [*Æōlūs*, the god of the winds: *Æolis*, in Asia Minor]: pertaining to Æolus, in Asia Minor; pertaining to Æolus, the fabled deity of the winds; in *geol.*, applied to wind-formed masses, as sand-hills. *ÆOL'IC*, a. *-ōl'īk*, pertaining to Æolia, or the Gr. dialect of Æolia. EOLIS: see ÆOLIS. EOLIAN HARP, a musical stringed instrument on which the wind acts to produce the notes.

EO'LIAN HARP: see ÆOLIAN HARP.

EOLIPILE, n. *ē-ōl'ī-pīl* [*Æōlūs*, the god of the winds, and L. *pīlā*, a ball]: a ball or sphere in which water is heated, and which turns round as the steam escapes through a bent pipe; Hero's engine.

EOLOPHON, or ÆLOPHON, n. *ē-ōl'o-fōn* [Gr. *aiolos*, moving with the wind, with changeful notes; *phōnē*, sound]: musical instrument, the seraphine, the predecessor of the melodeon and of the parlor organ.

EON, n. *ē'ōn*: see ÆON.

EON DE BEAUMONT, *ā-ōng' dēh bō-mōng'*, CHARLES GENEVIÈVE LOUIS AUGUSTE ANDRÉ TIMOTHÉE D' (known as the *Chevalier d'Eon*): 1728–1810, May 21; b. Tonnerre, in Burgundy. He studied law, became an advocate, and attracted the notice of the Prince of Conti by some political writings, and was introduced 1755 by the prince to Louis XV., who employed him in diplomatic missions to Russia and Austria. After serving a short time in the army, he was sent to London 1761 as sec. of embassy, and shortly after was made minister-plenipotentiary. Becoming the victim of a court cabal, however, which deprived him of his office, he took his revenge by publishing his secret correspondence with the French court, which contained libels on various persons. For one of these, he was prosecuted in London; and to avoid judgment fled to the continent. He, however, returned to England, but, on the death of Louis XV., the French ministry deemed it prudent to recall him, as they were afraid he might betray their secrets to the English government, which made him brilliant offers. The pretext laid hold of for this purpose, was the scandal excited in London by his having assumed the garb of a woman, which he had done at the request of Louis, the better, it may be presumed, to hide his designs as a ‘secret agent.’ On his return to France, however, Eon was very favorably received; and Louis XVI. even ordered him to make use of the feminine garb in future. In 1783,

EOPHONE—EÖTVÖS.

he again went to London, not, however, in any visible official capacity; and, though dressed as a woman, gave lessons in fencing, of which art he was a complete master. On the outbreak of the French Revolution he hastened home, and offered his services to the nation; but as nothing came of his offer, he finally returned to London, where he sank into the greatest misery and died. His writings appeared at Amsterdam 1775, under the title of *Loisirs du Chevalier d'Eon*. The *Mémoires* which bear his name are not genuine.

EOPHONE, *ē'ō-fōn*: a funnel-shaped instrument, varying in size, for converging to the ear sounds from a distance and for locating their source. The device being directed toward the probable source, the sound increases as the instrument is more truly pointed. It is valuable on shipboard in a fog.

EOPTERIS, n. *ē-ōp'tēr-īs* [Gr. *ēōs*, the dawn; *pteris*, a kind of fern]: in *paleon.*, *bot.*, genus of Filices containing the oldest known fern. It is Silurian.

EOS: see AURORA (goddess).

EOSCORPIUS, n. *ē-ō-skawr'pī-ūs* [*ēōs*, the dawn; *skorpios*, a scorpion]: in *paleon.*, genus of scorpions. *E. carbonarius*, from the carboniferous rocks of Ill., is the oldest known scorpion, except one found in the Niagara group.

EOSINE, n. *ē'o-sīn* [Gr. *ēōs*, the morning-red, daybreak]: roseate dye-stuff, tetrabromo-fluorescin, $C_{20}H_8Br_4O_5$; obtained by the action of bromine on fluorescin dissolved in acetic acid.

EOSPHORITE, n. *ē-ōs'fēr-īt* [Gr. *ēōs*, morning; *phoros*, bearing]: variety of childrenite.

EOTHERIUM, n. *ēō thēr'ī-ūm* [Gr. *ēōs*, the dawn; *thērion*, a wild animal]: in *paleon.*, genus of Sirenia, from the Eocene. *E. egypiacum* is the oldest known member of the Manatee order.

EÖTVÖS, *ā'öt-vösh*, JOZEF: 1813, Sep. 3—1871, Feb. 3; b. Buda: distinguished Hungarian author. He was educated at home by a tutor of republican sentiments, and studied philosophy and jurisprudence at the Univ. of Pesth 1825–31. He became an advocate 1833, but soon turned to literature, having already won reputation by his comedies *Kritikusok* (The Critics) and *Házasulók* (The Weddings), and by his tragedy *Bosszú* (Revenge). After his return from a journey through Germany, France, England, Switzerland, and the Netherlands, he published a work on *Prison Reform* (1838). This was followed (1838–41) by a novel, *The Carthusian*, pronounced one of the best productions of Hungarian literature. E. then began to distinguish himself in politics as a writer of incisive articles on the liberal side represented by Kossuth. *The Village Notary* (A' Falu' Jegyzöje, 1846; Eng. transl. 1850) is of the highest order, marked by variety of incident, easy vigor of style, humor, liveliness, and freshness of descriptive power. It was followed, 1848, by a powerful novel describing Hungary in 1514. When the revolution of 1848 broke out, E. was appointed minister of public instruction, but soon retired

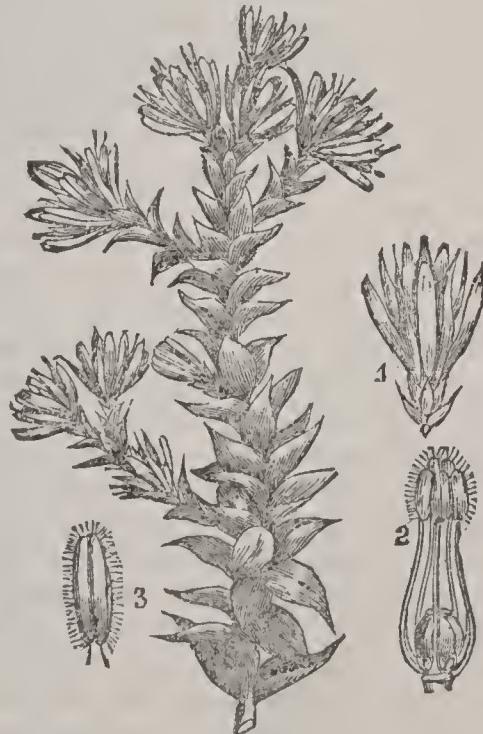
EOZOON—EPACRIS.

to Munich, where he employed himself exclusively in literary pursuits. The most important fruit of his residence here was a work (published in German and Hungarian, 1851–54) on the influence of the ideas of the 19th c. on the state and on society. In 1851 E. returned to Hungary. In 1859 he published anonymously a notable book (in German) on the guarantees for the power and unity of Austria. In 1867, he was appointed minister of worship and education, and in that capacity engaged actively in the work of reform. He died at Pesth.

EOZOON, n. *ēō-zōōn* [Gr. *ēōs*, dawn; *zōōn*, an animal]: a structure believed to be a fossil foraminifer, which must have grown in sheets on the sea bottom, though said by many to be of mineral origin. It occurs in certain limestones constituting reefs of rock in the Laurentian system of Canada. Dr. Dawson of Montreal named it Eozoon from its position in the oldest stratified rocks yet known to geology, and as being therefore the oldest known organism. See **LAURENTIAN SYSTEM**. **E'ozo'ic**, a. *-ik* [Gr. *zoē*, life]: a term applied to the oldest fossiliferous rocks of Canada, from their containing the earliest traces of life yet discovered; containing eozoon. The Laurentian system in Scotland has not as yet revealed any fossil remains. **Eozoonal**, a. *ēō-zōōn-al* [Eng. *eozoon*]: pertaining to or containing the fossil named Eozoon, or containing proof of the dawn of life. **Eozoic Period**: see **ARCHÆAN PERIOD**.

EP, prefix, *ēp*: see **EPI**.

EPACRIS, n. *ēp'ā-kriś* [Gr. *epi*, upon; *ākrōs*, the top, as found on the tops of hills]: a genus of very elegant green-



Springelia Incarnata:

1, flower and calyx; 2, anther; 3, stamens and ovary.

house plants, ord. *Epacridacēæ*, having in leafy spikes abundance of white, red, or purple flowers. **EPACRIDA-**

EPACT

CEAE, ē-păk-rĭd-ă'sē-ē, natural order of exogeneous plants, consisting of shrubs and small trees, which, both in appearance and in botanical characters, much resembles

the *Ericæ*, or Heath Family. The most important distinguishing structural character is indeed found in the simplicity of the anthers, which are one-celled, open longitudinally, and destitute of appendages. The flowers of the E. have generally a tubular corolla, dividing into five—rarely four—segments; which, however, sometimes become separate petals. The calyx is persistent, often colored, has the same number of segments with the corolla, and is surrounded with small bracts. The stamens are fewer than in the *Ericæ*, usually equal in number to the segments of the corolla, and alternate with them. The fruit is sometimes a capsule, sometimes a berry, sometimes a drupe. The leaves are simple, generally alternate, often crowded; the flowers in spikes, in terminal racemes; or axillary and solitary.—About 400 species of E. are known, all natives of the Indian Archipelago, the South Sea Islands, and Australia; in which regions they seem to occupy the place of heaths

Epacris Grandiflora,

of other parts of the world. Lindley has given the name Epacrids to this order. Some produce edible berries resembling the cranberry: see CRANBERRY.

EPACT, n. ē-păkt [Gr. *epaktos*, brought on or in, added—from *epi*, on; *agō*, I bring or lead to; F. *épacte*]: in *chronology*, excess of the solar month above the lunar synodical month; or of the solar year above the lunar year of 12 synodical months; or of several solar months above as many synodical months; or of several solar years above as many periods, each consisting of 12 synodical months. The menstrual epact is the excess of the civil calendar month above the lunar month. For a month of 31 days, this epact is 1 day 11 hours 15 minutes 57 seconds, if we suppose new moon to occur on the first day of the month. The annual epact is the excess of the solar year above the lunar. As the Julian solar year is (nearly) 365 days, and the Julian lunar year is (nearly) 354 days, the annual epact is nearly 11 days. The epact for two Julian years is, therefore, nearly 22 days; for three years, nearly 33 days; and so on. When, however, the epact passes 30 days, 30 falls to be deducted from it, as making an intercalary month. For three years, then, the epact is properly 3; and for 4 years, adding 11 days, it is 14 days; and so on. Following the cycle, starting from a new moon on Jan. 1, we find that the epact becomes 30 or 0 in the 19th year.



EPAGOGE—EPAMINONDAS.

The epact for the 20th year is again 11; and so on. The years in the cycle are marked by Roman numerals, I. II. III., etc., called the Golden Numbers; and a table of the Julian epacts exhibits each year in the cycle with its golden number and epact. As the Gregorian year (see CALENDAR) differs from, and is in advance of, the Julian by 11 days (the number lost on the Julian account before the Gregorian computation of time was introduced into England and her colonies), and as 11 days is the difference between the solar and lunar years, it follows that the Gregorian epact for any year is the same with the Julian epact for the year preceding it.

EPAGOGE, n. *ēp-a-gō'jē* [Gr. *epi*, on; *agō*, I lead]: in *rhet.*, the bringing forward of a number of particular examples to prove a universal conclusion; the argument of induction. **EPAGOG'IC**, a. [Gr. *epagōgē*]: of the nature of or pertaining to induction; inductive.

EPAMINONDAS, *ē-pam-ī-nōn'das*: B.C. 414—B.C. 362; most eminent of Theban generals and statesmen, and one who elevated and for a long period held his country at a high point of honor and prosperity. He was descended from an ancient but impoverished family, and led a retired life till his 40th year, profiting by the instructions of Lysis the Pythagorean, who inspired him with enthusiasm for elevated ideas. E. became prominent first during the period when the Lacedemonians garrisoned the citadel of Thebes, and kept the inhabitants in subjection. Though he took no part in the desperate but successful stratagem by which his fellow-citizens recovered the *Cadmeia*, B.C. 379, he stepped forward immediately afterward into the ranks of the patriots; and when sent to Sparta B.C. 371 with several others, to negotiate a peace between the two countries, E. evinced firmness, dignity, and eloquence in the debate which ensued on the question whether Thebes should ratify the treaty in the name of all Bœotia, the result of which ratification would have been equivalent to a recognition of her claim to supremacy over the Bœotian towns. To this the Lacedemonians demurred, and the war was resumed; E. was appointed commander-in-chief; and, in conjunction with his friend Pelopidas, with an army of 6,000 men, defeated double that number of the enemy at Leuctra (B.C. 371). Two years later, he and Pelopidas marched into the Peloponnesus, incited several of the allied tribes to fall away from Sparta, and then turned his arms against that city, which, however, was bravely defended by Agesilaus. On his return to Thebes, E. was accused of having violated the laws of his country, by retaining the supreme power in his hands beyond the time appointed by law; but was acquitted in consequence of his open and animated defense. In the spring of B.C. 368 the war was renewed with increased fury between Thebes and Sparta, and E. once more marched into the Peloponnesus, but did not accomplish much; and on his return home was checked by Chabrias at Corinth. To atone for this unsuccessful undertaking, he advanced with 33,000 men into Ar-

EPANADIPLOYSIS—EPAULEMENT.

cadia, and joined battle with the main body of the enemy near Mantinea, B.C. 362. E., at the head of his troops, succeeded in breaking the Spartan phalanx, but was mortally wounded in the breast by a javelin. Being told by the physicians that he would die as soon as the weapon was extracted, on receiving intelligence that the Boeotians had gained the victory, he is said to have torn out the javelin with his own hand, exclaiming: ‘I have lived long enough.’ His moral purity, justice, and clemency are extolled by the ancients as much as his military talents; and it is expressly recorded of him, that he never uttered a lie, even in jest. Compare Bauch, *Epaminondas und Thebens Kampf um die Hegemonie* (Breslau, 1834); Pomtow, *Das Leben des E.* (1870).

EPANADIPLOYSIS, n. ēp-ān-a-dī-plō'sis [Gr.—from *epanadiploō*, to make double, to repeat; *diploos*, double]: in *rhet.*, repetition; term applied to that figure in rhetoric when the sentence ends with the same words with which it begins.

EPANALEPSIS, n. ēp-ān-a-lēp'sis [Gr. *epi* and *analēpsis*, taking up again; repetition; *analambanō*, I take up again, I repeat]: in *rhet.*, figure of speech by which the same word or clause is repeated after a parenthesis.

EPANAPHORA, n. ēp-ān-āf'o-ra [Gr. *epanapherō*, I bring back, I repeat]: in *rhet.*, figure in which a word or phrase is repeated at the beginning of successive clauses.

EPANARTHOSIS: same as EPANORTHOSIS.

EPANASTROPHE, n. ēp-an-ās'tro-fě [Gr. *epanas*, *trepheō*, I return]: in *rhet.*, figure in which the end of one clause is made the beginning of the next.

EPANODOS, n. ēp-ān'o-dōs [Gr. *epi*, and *anodos*, a way up or back; *ana*, up; *hodos*, a way]: in *rhet.*, figure in which a sentence or member is inverted or repeated backward.—E. is also a return to the principal heads or to the proper subject of a discourse after a digression, or in order to consider the topics separately and more particularly.

EPANODY, n. ē-pān'ō-dī [Gr. *epanōdōs*, a rising, a return—from *epi*, upon; *anōdōs*, a way up, a return]: in *bot.*, an abnormal condition in which an irregular flower reverts to a regular form.

EPANORTHOSIS, n. ēp-ān awr-thō'sis [Gr. *epanorthooō*, I set straight; I correct—from *epi*, up; *anōrthooō*, I set straight up; *orthos*, straight]: in *rhet.*, figure of speech by which a person recalls what he has said, in order to substitute stronger or more significant words.

EPARCH, n. ēp'ārk [Gr. *eparchos*, the governor of a province—from *epi*, upon; *archē*, rule, supreme power]: the governor or prefect of a province in ancient Greece. **EPARCHY**, n. ēp'ār-kī, a province or territory under a governor; a territory or district in Russia. The modern kingdom of Greece is divided into provinces called *Nomarchies*, and a Nomarchy is subdivided into *Eparchies*.

EPAULEMENT, n. ē-pawl'mēnt [F. *épaulement*, a shoulder-piece—from *épaule*, the shoulder—from mid. L. *spatula*,

EPAULET—EPEIRA.

a shoulder]: in *siege-works*, a sidework to cover troops in flank, made of gabions, fascines, or bags of earth. The siege-batteries are generally shielded, at one end at least, by epaulements, forming an obtuse angle with the main line of the battery. The object is to protect the guns and gunners from a flanking fire. The name is often given erroneously to the parapet of the battery itself, but it applies properly to the flanking return only. Sometimes the whole of a small or secondary earthwork, including the battery and its flanks, is called an epaulement; and sometimes the same name is given to an isolated breast-work intended to shield the cavalry employed in defending a body of besiegers. EPAULE, the shoulder of a bastion, where one of the faces and one of the flanks meet.

EPAULET, or EPAULETTE, n. *ép'aw-lét* [F. *épaulette*—from *épaule*, the shoulder—from mid. L. *spātūlā*, a shoulder, a small sword: It. *spalla*, the shoulder]: ornament sometimes worn on the shoulder by naval and military men. EPAULETTED, a. furnished with epaulets.—Ranks and degrees are marked in a very systematic way by means of crowns, anchors, and stars worked in silver on the epaulette; also by the size of the cords of the epaulette itself. In the British army, epaulettes were abolished during the Russian war, because of the danger to which officers thus conspicuously marked were exposed. It is retained by the French army alone of the armies of the great European powers.

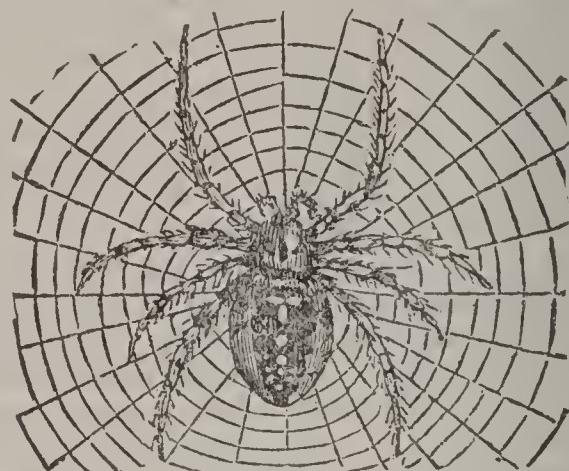
EPAXIAL, a. *ép-äks'i-al* [Gr. *epi*, upon, over; Lat. *axis*; Gr. *axōn*]: in *anat.*, pertaining or relating to muscles lying above the embryonic vertebral axis. They are called by Huxley episkeletal muscles.

EPÉE, *ä-pü'*, CHARLES MICHEL, Abbé de L': 1712, Nov. 25—1789, Dec. 23; b. Versailles, France: one of the founders of the system of instruction for the deaf and dumb. He entered into holy orders, and became a preacher and canon at Troyes, but on account of his Jansenist opinions, was deprived of this appointment, and lived in retirement in Paris. In 1755, he began to occupy himself with the education of two deaf-mute sisters; and, as he asserts, without any previous knowledge of Pereira's efforts in the cause, invented a language of signs for persons thus afflicted. At his own expense, he founded an institution for deaf-mutes, and labored with unwearyed zeal for it. His favorite wish, however, the foundation of such an institution at the public cost, was not fulfilled till after his death. He wrote *Institution des Sourds et Muets* (2 vols. Paris 1774), which afterward appeared in an improved form under the title, *La Véritable Manière d'Instruire les Sourds et Muets* (Paris 1784).

EPEIRA, *ä-pü'ra*: genus of spiders, type of a family called *Epeiridae*. They are of those spiders which have only a pair of pulmonary sacs and spiracles; construct webs with regular meshes, formed by concentric circles and straight radii, and are furnished with a pair of almost contiguous eyes on each side, other four eyes forming a quadrangle in the centre. Many of them are remarkable for beauty of colors and forms. Several species abound in gardens, par-

EPENCEPHALIC—EPIERIES.

ticularly in autumn. *E. diadema* is one of the largest. It is found in moors, the borders of woods, etc.; but it is in tropical countries that the *Epeiridae* are in greatest numbers, and attain the greatest size and beauty. The net, when loaded with wings, wing-covers, and limbs of insects that have been preyed upon, is often loosened, and falls down upon the central nest or den of the spider; and successive



Epeira Diadema.

nets thus falling down, form at last a ball sometimes as large as a man's head. Some of the spider cords, carried horizontally from tree to tree at a considerable height from the ground, 'are so strong as to cause a painful check across the face when moving quickly against them; and more than once,' Sir J. E. Tennent says, 'in riding I have had my hat lifted off my head by a single thread.'—Tennent's *Ceylon*.

EPENCEPHALIC, a. ēp-ēn-sē-fāl'ik [mod. L. *epencephalon*]: in *anat.*, pertaining or relating to the epencephalon; the occipital or back part of the brain. **EPENCEPHALON**, n. -sēf'āl-ōn [Gr. *epi*, upon; *engkephalos*, the brain]: in *anat.*, portion of the brain which, with the metencephalon, constitutes the posterior primary vesicle. The epencephalon comprehends the cerebellum, the pons Varolii, with the anterior part of the fourth ventricle.

EPENCHYMA, n. ēp-ēng'kī mă [Gr. *epi*, upon; *chumos*, juice]: in *bot.*, the fibro-vascular tissues.

EPENDYMA, n. ēp-ēn'dī mă [Gr. *ependuma*, an outer or upper tunic—from *epi*, upon; *enduma*, clothing]: the delicate epithelialized structure which lines the canal of the spinal cord and the cerebral ventricles. **EPENDYMA-VENTRICULORUM**: same as EPENDYMA.

EPENTHESIS, n. ē-pēn'thē-sis [Gr.—from *epi*, on or upon; *entithēmi*, I put or set in]: in *gram.*, the insertion of an additional letter or syllable in the middle of a word. **EPENTHET'IC**, a. -thēt'ik, inserted in.

EPERGNE, n. ē-pērn' [F. *épargne*, economy]: an ornamental stand with dish and branches for the centre of a table.

EPIERIES, ā-pā-rē-ēsh' [Lat. *Fragopolis* or *Eperesinum*; Hung. *Eperjes*; Slovak, *Pressoval*]: old town of Hungary,

EPERNAY—EPHELIS.

county of Saros, of which it is the capital; agreeably situated on the left bank of the Tarcza, about 150 m. n.e. of Pesth. It is surrounded with walls, is the seat of a bishop, and contains some houses of the 15th and 16th c., built in the style of those in Naples, with which E. was much connected in the middle ages. Its principal buildings are the Church of St. Nicholas, the communal college, with 500 students and a library of 14,000 vols., and the county hall. It has manufactures of earthen ware and of linens and woolens, and has some trade in linen goods, grain, and Tokay wine. In the vicinity are the Sovar saltworks, which produce 5,000 tons of salt annually. Pop. about 11,000, mostly Slavs, with a few Germans.

EPERNAY, *ā-pēr-nā'*: town of France, dept. of Marne, headquarters of the *Vins de Champagne*; in the midst of a rich vine-growing district, on the left bank of the Marne, 19 m. w.n.w. of Chalons. It is well built, clean, and well paved. Its environs consist, for the most part, of elegant villas, with vaults attached, belonging to the Champagne wine-merchants. E. manufactures large quantities of earthen-ware from a clay obtained in the neighborhood, and called *Terre de Champagne*; also hosiery, refined sugar, and leather. It has a brisk trade in bottles, corks, wire, champagne wines, etc. Pop. (1896) 19,377.

EPERUA, n. *ē-pēr'ū-ā* [from *eperu*, Guianan name of the fruit of *Eperua falcata*]: genus of leguminous plants, sub-order *Cæsalpinieæ*, tribe *Amherstieæ*. *E. falcata*, the Wallaba tree of Guiana, has abruptly pinnate leaves, and peduncles of flowers. Sir R. Schomburgh says that the wood is deep red, frequently varied with whitish streaks, hard, heavy, shining, impregnated with an oily resin, and in consequence very durable.

EPEXEGESIS, n. *ē-pēks-ē-jē'sis* [Gr. *epexēgeomai*, to narrate in detail; *ex*, out; *hēgeomai*, to lead]: a full or detailed account or explanation of something which has gone before; exegesis. EPEXEGETICAL, a. *jēt'ik-al* [Gr. *epi*, and *exegetical*]: of the nature of an epexegesis; explanatory of something which has gone before; exegetical.

EPHAH, or EPHA, n. *ē'fă* [Heb. *ephah*]: Hebrew dry measure of about 3 pecks 3 pints

EPHEBIDÆ, n. *ē-fē'bō-dē* [Gr. *ephēbos*, a kind of cup]: family of lichens, tribe *Hymenothalameæ*. Ephebe is the type.

EPHEDRA, n. *ēf'ē-dra* [L. *ephedra*—from Gr. *ephedra*, a setting by or at a thing, a plant, perhaps *Equisetum sylvaticum*]: genus of *Gnetaceæ*. The flowers are dioecious. The species occur in all parts of the world. Their fruit is said to be mucilaginous, eatable, sub-acid, and slightly pungent. The branches and flowers of the Asiatic ephedras were formerly sold as styptics.

EPHELIS, n. *ē-fē'līs* [Gr. *epi*, upon; *hēlios*, the sun]: term for the freckles which appear in persons of fair complexion, on those parts of the skin exposed to the sun.

EPHEMERA.

EPHEMERA, n. *ě-fěm'ě-rū* [Gr. *ephēmērōs*, lasting but a day—from *epi*, on; *hēmērā*, a day]: that which lasts but a day; a fly that lives a day, or for a short period; in *med.*, a kind of fever (*febris diaria*) that lasts but a day or part of a day, usually arising from some local irritation. EPHEMERAL, a. *-äl*, continuing or existing one day only; short-lived. EPHEMEREÆ, n. plu. *ěf-ě-měr'ě-ē* [mod. L. *ephemerum*; L. adj. suff. *-eæ*]: tribe or family of inoperculate terminal foliated mosses. *Ephemerum* is the type. EPHEMERID, n. *ě-fěm'ěr-ěd*, insect of the family *Ephemeridæ*. EPHEMERIS, n. *-is*, a daily account; an almanac containing the daily positions of the sun, moon, and planets, with useful information respecting the other heavenly bodies, and of such phenomena as depend upon them; a table of the positions of a heavenly body, as the *ephemeris* of the sun: such tables have become common since the days of Kepler. The first were published by Purbach for the years 1450-61. Those of Regiomontanus, for 1474, were much more accurate, and his *Ephemerides* met with universal acceptance. Similar publications were afterward made by Leovitius, Origanus, Kepler, and others. Among the most important of these numerous works at present are the French *Connaissance des Temps*, the English *Nautical Almanac*, the Berlin *Astronomisches Jahrbuch*, and the American *Ephemeris and Nautical Almanac*. EPHEMERIDES, n. plu. *ěf'ě-měr'ě-děz*. EPHEMERIST, n. one who studies the daily motions of the planets by means of an *ephemeris*. EPHEMERITES, n. *ě-fěm'ěr-ěts*, in *paleon.*, presumed genus of *Ephemeridæ* of Carboniferous age. EPHEMEROMORPH, n. *ě-fěm'ěr-o-mawrf* [Eng. *ephemeron*; Gr. *morphē*, form]: term coined by Bastian, to include the lowest forms of life under one general designation. EPHEMERON-WORM, n. the *ephemera* which, however, continues long in the worm or larva state. It is when it reaches the perfect state that it is ephemeral in the duration of its life.

EPHEM'ERA [Gr. lasting for a day]: Linnæan genus of neuropterous insects, now forming the family or tribe *Ephemeridæ*. They are allied to the *Libellulidæ*, or Dragonflies, but differ from them in many very important respects. They have received their name, to which corresponds the English DAY-FLY, sometimes also applied to them, from the brief duration of their existence in the perfect state, in which, very unlike the dragon-flies, they are believed to take no food, merely propagating their species, and dying. From the season of the year in which they begin to be seen, some of them are called also MAY-FLY; and by this name are well known to anglers, who use them, and artificially imitate them as excellent lures for trout. The eggs also of the *ephemeræ* are favorite food of fishes; they cohere together in a gelatinous mass. The larvae and pupæ are aquatic, and in these states the *ephemeræ* have much longer life than in their perfect state, extending even to years. The larvae and pupæ are voracious. The abdomen of the larva is furnished on each side with a set of leaflets, which serve instead of gills for respiration, and are used also in locomotion,

PLATE 1.

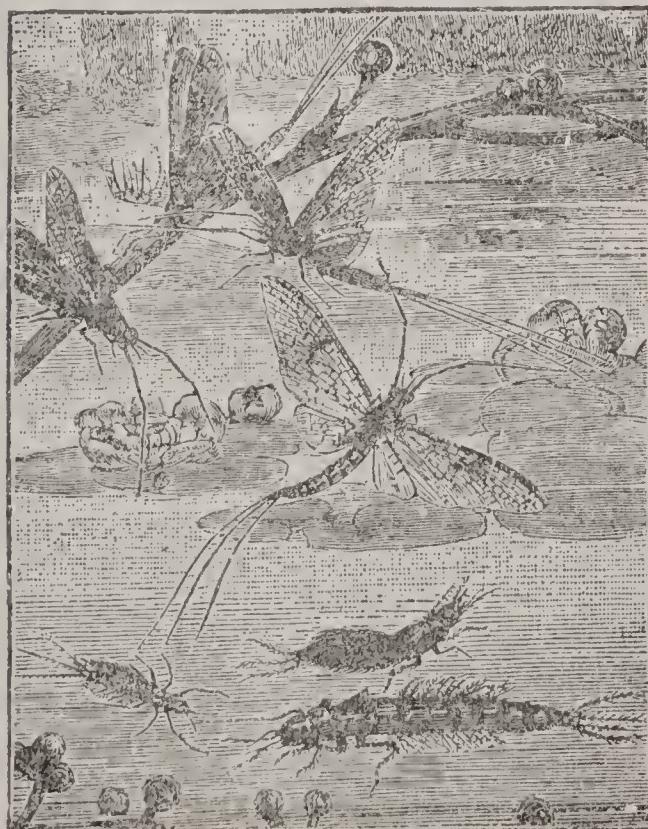
Epaulement
Ephemera



Epaulement.—From *Encyclopédie Militaire.*



Epergne.



Ephemera.—Metamorphoses of the May-fly.

EPHESIAN—EPHESIANS.

though there are six feet attached to the thoracic segments. The pupæ differ little from the larvæ except in having rudimentary wings inclosed under scales. Both larvæ and pupæ have the abdomen terminated by two or three jointed filaments, which the perfect insect also has, sometimes very long. The body of the perfect insect is soft and slender; the wings resemble in form those of dragon-flies, but are soft and filmy; in repose, they are elevated vertically above the body: the second pair of wings are much smaller than the first, and in some species are altogether lacking; the organs of the mouth are so soft and small as not easily to be discerned, and to be apparently unfit for any kind of use. Ephemeræ, in their larva and pupa states, live chiefly under stones in water, or in burrows which they make in the banks of streams. When ready for their final change, they creep out of the water to undergo it on some plant or other object by the water-side, generally toward sunset on some fine day of summer or autumn. After having attained their winged state, however, they cast off a complete slough or envelope, so perfect, that it exhibits even the limbs, abdominal filaments, and antennæ; and these ‘ghost-like exuviae’ are sometimes so abundant in the neighborhood of streams, as to cover in ‘a pearly layer’ the hat and basket of the angler. The multitudes of ephemeræ are often very great, filling the air as a cloud; nay, so abundant are they at times, that their bodies have been known to cover the ground in certain districts of France, and have been gathered from particular spots in cart-loads to be used as manure.

EPHESIAN, a. *ĕf-ĕzhi-ăn*: pertaining to *Ephesus*: N. a native of Ephesus, in Asia Minor.

EPHESIANS, EPISTLE TO THE: universally received as a genuine work of the apostle Paul. The only doubt in connection with it is whether it was addressed particularly to the church of Ephesus, or to some neighboring church or churches. Among the reasons for the doubt are: 1. Basil (became bp. of Cæsarea 370) says that the earlier writers whom he had consulted declared that in their copies of the epistle it was not addressed to any church by name; and that this was the fact also in the ancient manuscripts that he had seen. 2. In agreement with this testimony it has been discovered in recent times that the words ‘in Ephesus’ are not in the text of the Vatican and Sinaitic manuscripts, which are the oldest and best now known. 3. Marcion (wrote about 150) says that in his collection this epistle was addressed to the Laodiceans. But, as he was heretical in his opinions, and took strange liberties in matters relating to the Scriptures, his testimony is not to be trusted, unless confirmed by other witnesses. 4. In the epistle itself Paul says only that he had *heard* of the Christian faith of those whom he addressed; he seems also to imply that they may not have known of his mission as the apostle to the Gentiles; he sends no salutations to personal friends; and makes no allusion to his having ever lived among those to whom he wrote. These things are natural if the epistle was addressed to strangers, but hard to explain if it was

EPHESITE—EPHESUS.

written to a church founded by his own personal labors and perils, whose members he had counselled faithfully for three years, and whose elders had parted from him at Miletus with tears. In view of these reasons some suppose that the epistle was originally sent in succession to several churches, one of which was at Ephesus, and another, perhaps, at Laodicea. But its usefulness did not at first depend on its particular destination; nor is it now less useful because that destination is not certainly known. The very absence of local allusions and restrictions may make it better adapted to instruct the churches of all times and in every land. I. The *doctrinal* part of the epistle (which is informal in its method, and exultant in its terms) exhibits: 1. The glorious character of God, the Father of all, in his love, justice, mercy, and grace in Christ, by whom he provides redemption for men, Gentiles and Jews, according to the revelation of his eternal purpose bursting forth first on the darkness of this world, and to be fully manifested, at last and forever, among the principalities and powers of heaven. 2. The resurrection of Christ from the dead, followed by his exaltation to supreme power over all things for the welfare and perfection of his church. 3. The lost state of sinful men from which redemption delivers those that believe. 4. The full knowledge and personal experience of the blessings provided for Christians to be attained, in answer to prayer, through the working in them of that mighty power by which Christ had been raised from the dead and exalted in heaven. II. The *practical* part exhorts Christians to strive for the attainment of: 1. Unity of the spirit among themselves. 2. Holiness of heart and conduct. 3. Loving fidelity in the various relations of life. 4. Persevering activity in maintaining the conflict against spiritual adversaries, through strength to be derived from the Lord, and in the use of the whole armor which he supplies.

EPHESITE, n. *ĕf'ĕ-sīt* [from *Ephesus*, in the vicinity of which it occurs]: pearly white mineral, hard enough to scratch glass.

EPHESUS, *ĕf'ĕ-sūs*: one of the twelve ancient Ionic cities of Asia Minor, in Lydia, near the mouth of the river Caystrus, in the midst of an alluvial plain. It does not appear to have been as old as the Trojan war, but its primitive history has been confused by myths. It bore a great variety of names at different times, the principal of which, besides E., were Ortygia and Ptelea. According to Strabo, it was founded by Androclus, son of Codrus, and this is the most probable of the accounts which have come down to us, though others held to the tradition of its Amazonian origin. It was long before E. acquired any political importance, in spite of being a sacred city from an early period. Subdued first by the Lydian, and next by the Persian kings, it was included, after the death of Alexander the Great, in the territories of Lysimachus (B.C. 281), by whom it was greatly strengthened. Ultimately, it came into possession of the Romans; and in the time of

EPHESUS.

Augustus, when Strabo wrote, it was 'the greatest place of trade of all the cities of Asia w. of the Taurus.' This was its condition when visited by the apostle Paul, who resided here three years; but the destruction of its great temple by the Goths, A.D. 260, gave it a blow from which it never recovered. In 341, it was the scene of the *third* general council of the Christian Church. Its general history, while a city of the Byzantine empire, was unimportant, and before the days of Tamerlane it had almost completely perished.—The ruins of E. comprise a stadium 687 ft. long, fragments of a great theatre (alluded to in the account of the apostle Paul's preaching in the city), of an odeum or music-hall, and of various walls and towers, belonging to the Greek, Roman, and Byzantine eras. Near the w. extremity of the town are some massive structures, which have since 1868 been carefully excavated, at some spots, from beneath 18 ft. of soil. It is now certain that these stand on the site of the famous *Temple of Diana*. This marvellous building, one of the seven wonders of the world, was originally built by Chersiphron; but after its destruction by Herostratus on the night (as is said) when Alexander the Great was born (B.C. 356), it was rebuilt by the inhabitants in a style of greater splendor than before, the very women contributing their ornaments to secure the necessary funds; yet, notwithstanding this enthusiasm, more than 200 years elapsed before the new edifice was completely finished. It was the largest Greek temple ever constructed. Its length was 425 ft., its width 220, the number of its columns 128, of which 36 were carved, and their height 60 ft. It had an area more than four times that of the Parthenon at Athens, and even the Olympeum was only about two-thirds as great. But more wonderful than the temple itself were the numberless statues and pictures which it contained, executed by the best masters of Greece. The altar of the goddess was adorned principally with the works of Praxiteles. Certain cabalistic words, said to have been inscribed on the figure of Diana, were copied and carried about as charms. The vast temple, plundered of its treasures by Nero, and burned (as has been mentioned) by the Goths, was most likely finally destroyed by the iconoclasts, in the reign of Theodosius I., who issued his celebrated edict against the ceremonies of the pagan religion 381. The site of E. is now occupied by some wretched villages, the principal of which is Ayasaluk.—See the works of Gulil, Ernst Curtius, and Zimmermann, and Wood's account of his explorations in 1868-9.

EPHESUS, COUNCILS OF: two ecclesiastical assemblies. I. The third ecumenical council was summoned by Emperor Theodosius II. to meet about Pentecost, 431, to settle a complicated controversy, involving the following: 1. Differences of philosophical statement concerning the union of the divine and human natures in Christ; 2. Strife among bishops and churches, aggravated by their ambition and jealousy, and by assumed imperial authority over them;

EPHIPPIUM—EPHOD.

3. The homage increasingly rendered to Mary, the mother of Jesus, expressed in part by calling her 'the mother of God.' This controversy found its centre in Nestorius, bp. of Constantinople, who opposed the title 'mother of God,' but was willing to say 'mother of Christ.' At the time appointed many of the bishops were present, but some were detained by bad roads and other hindrances. After waiting two weeks the majority (consisting of 160 bishops), under the arbitrary lead of Cyril, bp. of Alexandria, having organized the council, condemned Nestorius and deprived him of his office. The detained bishops having arrived soon after, both sides appealed to the emperor, who permitted Nestorius to return to the monastery from which he had been called. II. The 'Robber Synod' (as history justly calls it), consisting of 135 bishops; convened by Theodosius (449) to consider again the controversy to which Nestorius gave name, and which, since his deposition, had become even more violent. In the proceedings of this council no opposition to the will of the president, Dioscuros, bp. of Alexandria, was allowed; the bishops were overawed by monks, soldiers, and brawny servants, and were compelled to sign blank papers, to be filled up as the leaders chose. These lawless methods, as well as the violent measures carried through by their aid, hastened a crisis in the Eastern Church, and greatly furthered the advancing power of the bp. of Rome, by compelling an appeal to him against oppression and wrong.

EPHIPPIUM, n. *ē-fip'pi-ūm* [L.—from Gr. *ephippion*, anything placed on a horse's back, such as a horse-cloth, or a saddle; *epi*, upon; *hippos*, a horse]: in *zool.*, a receptacle on the back of the entomostrocan called Daphnia, in which the winter eggs are deposited.

EPHOD, 'n. *ēf'ōd* [Heb.]: vestment worn by the Jewish high-priest over the *Mēil* or second (purple) tunic. It consisted of two shoulder-pieces, one covering the back, the other the breast and upper part of the body, not unlike the Greek *epōnis*. Two onyx stones set in gold fastened it on the shoulders, and on each of the stones were engraved the names of six tribes, according to their order. The material of which the E. was wrought was extremely costly and magnificent: 'gold, blue, purple, crimson, and fine twined linen.' A girdle or band, of one piece with the E., fastened it round the body. Just above this girdle, in the middle of the E., and joined to it by little gold chains, rings, and strings, rested the square oracular breast-plate with the mysterious *Urim and Thummim*. See HIGH-PRIEST: URIM AND THUMMIM.

Originally intended to be worn by the high-priest exclusively: ephods of inferior material seem to have been in common use in later times by the ordinary priests. Even David, when bringing the ark back to Jerusalem, appeared in one. There is mention made of an ephod also in several passages of the books of Judges and Samuel, where the word must needs stand either for the *whole* priestly apparatus of an illegal service, or simply for a

EPHOR—EPHRAEM SYRUS.

statue or an idol: the Talmud understands this E. to have been a colossal shoulder vestment of gold, to which divine honors were rendered.

EPHOR, n. *ĕf'ōr*, **EPHORI**, n. plu. *ĕf'ōr-ī* [Gr. *ephorāō*, I look at or over]: order of magistrates in ancient times which appears to have originated at Sparta, and to have been peculiar to the Doric governments. When or by whom the ephori were first instituted is uncertain. Herodotus attributes their creation to Lycurgus, and Aristotle to Theopompus (B.C. 770–720). Their duty was to superintend the internal administration of the state, especially affairs of justice, for which a particular building was assigned them, called the Ephorion. One of their most important functions was the oversight, at least in part, of the education of youth, for we are told by Athenæus that they inspected the clothing and bedding of the young men. The ephori were five in number; they were elected by and from the people—on which Aristotle observes, that through them the *demos* enjoyed a participation in the highest magistracy of the state; and held their office for only one year. Their influence gradually increased, for their powers were so ill defined that it was difficult to say what was *not* under their cognizance and authority. Cicero draws a comparison between the ephoralty of Sparta and the tribunate of Rome, which is not unwarranted by the facts of the case. Ultimately, the kings themselves became subject to the supervision of the ephori. Cleomenes, for example, was brought before them for bribery; Agesilaus was fined, and Pausanius imprisoned; and in extreme cases they could prefer charges against the kings, and have them tried before the supreme criminal court. They also transacted negotiations with foreign powers, subscribed treaties, raised troops, ‘ intrusted the army to the king or some other general,’ and, in fact, acted as the executive of the state. Muller regards the ephoralty as ‘the principle of change in the Spartan constitution, and, in the end, the cause of its dissolution.’ In the hands of the ephori, the constitution of Sparta certainly ceased to be a genuine aristocracy, and became a sort of oligarchy; but the subject is involved in obscurity and perplexity. Their authority was at last destroyed by Agis and Cleomenes, who murdered the ephori then ruling, and restored the old Spartan constitution, B.C. 225.

EPHRAEM SYRUS, *ĕ'fra-ĕm sîr'ūs*: one of the most celebrated and prolific ecclesiastical writers of the Syrian Church: died, Edessa, 378. Several accounts of his life have been handed down to us, but all are more or less legendary. It appears, then, that Ephraem (Heb. *Ephraim*) was born in the early part of the reign of Constantine the Great, ‘somewhere between the Euphrates and Tigris,’ probably at Nisibis. His parents were, according to some, heathens; and E., repudiating their idolatry at an early age, had to leave their roof. Jacob, Bp. of Nisibis, took care of the boy, and undertook his education. His progress in learning was so satisfactory that the bishop

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was soon able to make him teacher at his own school; and when in 325 Jacob went to the council of Nicæa, E. accompanied him thither. In 363, Nisibis was ceded by Jovinian to the Persians, and E. first retired into Roman territory, then went to Anid, his mother's birth-place, and finally settled in Edessa (Orfa), where he remained until his death. He is said to have been so poor when he first arrived at Edessa, that he was obliged to take service at a public bath, but he soon became acquainted with hermits of the neighborhood, and adopted their habits: he retired into a cave near the town, and led the life of a recluse. But so great were his piety and asceticism, as well as his readiness to help the poor and tend the sick, that he was looked upon as a saint, and his day is still celebrated, at different dates, in various churches. Among his usual denominations, referring especially to his teachings and writings, are 'Prophet of the Syrians, Column of the Church, Harp of the Holy Spirit,' etc.; and his name is never mentioned without the 'Mor' or 'Mari' (Lord, My Master) being prefixed. But for all that, he had no lack of enemies. His burning zeal for preaching and converting led him to attack most fiercely almost every one beyond the pale of his peculiar creed. He spoke and wrote unceasingly against Idolaters, 'Chaldees,' Jews, and heretics of all kinds, especially Arians, Sabellians, Manichaens, Novatians, etc. Toward the end of his life, he paid a visit to Basil the Great, in Cappadocian Cæsarea, who could not prevail upon him to accept of any higher office in the church than a deanery, though he spared no effort to make him bishop. Returned to Edessa, he found plague and famine raging there, and to his over-exertions for the relief of the sufferers his death is attributed by some. He expired in the same year with Basil, having given the strictest injunctions that his burial should be of the very simplest description. The Testament which he is reported to have dictated in his dying hour—much as it has been used for biographical purposes—is entirely spurious.

The visit to Basilius, unimportant as it seems, has been of very great moment. The legend which surrounds this, as all other incidents of his life, with a halo of miracle, records that the two men, though previously ignorant of each other's language, began to speak them fluently at this interview—Basilius Syriac, and E. Greek. This wonderful story first induced the learned to enter upon the question, whether E., half of whose voluminous works are in Greek, did really understand that language; and further, whether he understood any language but his own, Syriac. If he did not, what view was to be taken of his Commentaries on the Bible, of which the Hebrew and Greek texts, as well as the Septuagint and the Greek Fathers, must have been a sealed book to him. There were, and are still, great differences of opinion on these points, but it is generally supposed now, that he did not understand any language but his own; that he made use of the common Syriac version, the Peshito; that his grammatical and linguistic notes are taken from different Syriac Commentaries, and that the Greek portion

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of his works consists partly of translations made from his Syriac after his death, or even during his lifetime, and partly of interpolations. Both the praise and the blame which have been indiscriminately bestowed upon him as a writer are exaggerated. His chief merit lies in the glowing fervor and the deep piety which he infused into all he wrote, particularly into his elegiac hymns. Diction and form are poetical throughout, and when not soaring into the infinite, of real beauty. The effect is heightened by the matchless simplicity and awing grandeur of the Syriac idiom.

Of his principal works and their editions, those (under his name) in Greek, consist of Sermons or Homilies, and Treatises of an exegetic, dogmatic, and ascetic nature. Photius records that he wrote more than a thousand such sermons; Sozomenos speaks of '300 myriads;' but, of those that have come down to us, some are spurious, and others at least dubious. Gerhard Vossius translated 171 treatises from Greek MSS. found in Italian libraries, into Latin, and published them at Rome, 1589-98, in 3 vols. (There is but one piece in them translated from the Syriac.) They were reprinted in Cologne 1603, 1619, 1675; also in Antwerp 1619. The first Greek edition appeared in Oxford 1709, edited from 28 Oxford MSS. by E. Thwaites. The most important of his Syriac works are, besides an immense variety of homilies, sermons, poems, etc., his commentaries, or rather scholia, on parts of the Old Testament. Their value to us, however, is limited to their aiding us in explaining and fixing some readings of the Peshito (see PESHITO), and in enriching our critical apparatus. That he also commented on the Gospels is certain, but no MS. has been found as yet, not even in a Greek or Arabic translation. As to the songs and prayers in the Syrian Liturgy ascribed to E., the fact is that they are merely composed in his manner, and betray their comparatively recent origin at the first glance. The principal edition of his works in Syriac and Greek was published in 6 vols., Rome, under the papal authority (1732-46).

The principal writers on E. are: Sozomenos, *Hist. Eccl.* iii. 16; Assemani, *Proleg.* and *Biblioth. Orient.*; Credner (1827); Lengerke, *Comm. de Ephr. Syr.* (1828), and *De Ephr. Syr. Arte Hermen.* (1831); Morris (*Select Works of E.*, 1847); Burgess (*Select Metrical Hymns of E.*, 1853); Rödiger (in Herzog's *Realencyklopädie*); Overbeck (Syriac text, 1865); Bickell (with Latin translation, 1866).

EPHRAIM, ē'fra-im: younger son of the Hebrew patriarch Joseph by his wife Asenath, and the founder of one of the 12 tribes of Israel. It is possible that he may have received his name, which signifies 'double fruitfulness,' from having been born during the seven years of plenty. His grandfather Jacob, shortly before his death, prophesied the greatness of his posterity when giving him his blessing: 'His seed shall become a multitude of nations' (Gen. xlvi. 19). After the Israelites had left Egypt, the tribe of E. numbered 40,500. (Numbers, i. 32, 33); but from

EPHYRA—EPIC.

causes not specified, and not discoverable, it had sunk 40 years later, on the eve of the conquest of Canaan, to 32,500 (Numbers, xxvi. 37). Yet it was under the leadership of an Ephraimite, Joshua, the son of Nun, that the Canaanites were subjugated, and the land possessed. This seems to have given the tribe a much higher influence than might have been expected from its numerical strength. We find Judah and E. classed together as taking their inheritance first (Josh. xv. xvi., etc.).—The precise boundaries of E., as of the other tribes, it is impossible to determine. It occupied the centre of Palestine, was bounded on the s. by Dan and Benjamin, and stretched from the Jordan on the e. to the Mediterranean on the west. From scattered notices of the Ephraimites in the earlier annals of the Hebrews, we infer that they were, on the whole, jealous of their brethren. This feeling of dissatisfaction at length broke out into rebellion in the reign of Rehoboam, and the new kingdom of Israel, ruled over by Jeroboam, was for the most part merely the kingdom of E., for the land which lay n. of it could hardly be said to be actually in the possession of the tribes whose names it bore, the original inhabitants keeping stubborn hold of their cities and strongholds. See JEWS.

EPHYRA, n. *ĕfī-ra* [L. *Ephyra*; Gr. *Ephura*, old name of Corinth]: pseudo-genus of *Rhizostomidae*, being the 'hydratuba' or larva state of *Aurelia* or other true genera of the family; genus of geometer moths.

EPI, prefix, *ĕp'ī* [Gr.]: on; upon; during; on the outside or above: *epi* has the forms *ep* and *eph*; *ep* is used before a vowel, *eph* with an aspirate, and *epi* before a consonant.

EPI, *ĕp'ī*, or GIROU'TTE, *jîr-ô-ĕt'* [Fr]: species of ornamental ironwork with which the cones of pavilions or pointed roofs are sometimes surmounted in the renaissance style of architecture. One of the finest examples surmounts the Tourelle aux Pastorals at the Hôtel de Bourgtheroulde in Rouen, France.

EPIBLAST, n. *ĕp'ī-blăst* [Gr. *epi*, upon; *blastos*, a shoot]: an abortive organ in the oat, supposed to be the rudiment of a second cotyledon.

EPIBLEMA, n. *ĕp'ī-blē'mă* [Gr. *epiblēma*, an upper garment, a patch—from *epiballō*, I put on—from *epi*, upon; *ballō*, I throw, I cast]: an imperfectly formed epidermis covering the newly formed extremities of roots, etc., being, as it were, the tissue which first covers wounds.

EPIC, a *ĕp-ĭk* [L. *epicūs*; Gr. *epikōs*, epic—from Gr. *ĕpos*, a song: It. *epic*: F. *epique*]: narrative; heroic. EPIC POEM, a poem that contains a narrative or story.—The two chief kinds of poetry, are Epic poetry and Lyric poetry. Epic poetry has outward objects for its subject, of which it gives an imaginative narrative. The events themselves may be partly real and partly fictitious, or they may be altogether fictitious. Lyric poetry, on the other hand, sets forth the inward occurrences of the writer or speaker's own

EPICALYX—EPICHARMUS.

mind—his feelings and reflections. No composition, perhaps, answers, in all its parts, to the one of these descriptions, or to the other; but a piece or poem is classed as epic or lyric according to the element that predominates. Under each of these grand divisions, or genera, there are subdivisions, or species. The longer poems of the epic genus embrace an extensive series of events, and the actions of numerous personages. The term *heroic* epic, or *heroic* poem, is properly applied to such works as the *Iliad* and *Odyssey* of Homer, Virgil's *Aeneid*, Tasso's *Jerusalem Delivered*, Ariosto's *Orlando Furioso*, and others, which describe the achievements of the gods and heroes of antiquity, or of the almost equally mythic knights of mediæval chivalry. Poems like Milton's *Paradise Lost* and Dante's *Divina Commedia*, are *sacred* epics. Byron's *Childe Harold*, with the length and narrative structure of an epic, abounds in reflection, sentiment, and satire, and thus is, in substance, as much lyric as epic. Productions like those now named form the class of grand epics, or epic poems, by way of eminence. But there are also several species of minor poems which, from their nature, must be ranked as epics. One of these is the *Idyl*, a term applied to what is called *pastoral poetry*, or to descriptions in general of natural scenery, and of the actions and manners of men in calm, ordinary life. Burns's *Cotter's Saturday Night*, Goldsmith's *Deserted Village*, and most of Crabbe's poems, are idylls; so are poetical epistles. The *ballad* (q.v.) is another species of minor epic.

Attempts at epic poetry are now rare, the spirit of the age being against that form of composition. Instead of epic poems, we have *novels*, which, so far as subject is concerned, may be considered as the epics of modern civil and domestic life.

EPICALYX, n. *ĕp'i-kā'lĭks* [Gr. *epi*, upon; Eng. *calyx*]: the outer calyx, consisting either of sepals or bracts, as in mallows, or probably of stipules of the sepaline leaves.

EPICARP, n. *ĕp'i-kārp* [Gr. *epi*, upon; *karpos*, fruit]: the outer skin of fruits—the fleshy or edible portion being called the *sarcocarp*, and the stone the *endocarp*.

EPICENE, a. *ĕp'i-sēn* [L. *epicænus*, of both sexes—from Gr. *koinos*, common]: in *gram.*, common to both sexes. **EPICENE NOUNS**, names of animals which take their gender from their termination without regard to sex.

EPICHARMUS, *ĕp-i-kár'mūs*: Greek poet; b. in the island of Cos, b.c. 5th c. At first, he studied philosophy under Pythagoras; but a residence at Megara, the native soil of comedy, gave him a taste for that branch of the drama. After the destruction of Megara, b.c. 484, he removed to Syracuse, where, at the court of Hiero, he spent the remainder of his life. From this circumstance, he is often mentioned by the ancients as a Sicilian. Almost nothing else is known of his personal history except that he died at the age of 90, or, as some say, 97: the date is unknown. E. is called by Theocritus the father of comedy, and Plato assigns him a place among comic writers as high

EPICHILIUM—EPICOROLLINE.

as that of Homer among epic poets. He certainly did good service in excluding, to a large extent, from his dramas the vulgar buffoonery which disgraced all previous comedies, and in introducing a regular plot in which the *comus* or band of revellers sustained the dialogue. None of E.'s works survive entire; but we possess several fragments and the titles of 35. They embraced a wide variety of topics, mythological, social, and political. From one of them, Plautus borrowed the plot of his *Menaechmi*, which shows great constructive skill. The fragments of E. have been collected and edited by H. P. Krusemann (Haarlem 1834). Compare Lorenz, *Leben u. Schriften des E.* (1864), and Guigniant, *Histoire de la Comédie Antique* (1863).

EPICHILIUM, n. *ĕp'ĭ-kil'ĭ-ūm* [Gr. *epi*, upon; *cheilos*, a lip]: in bot., the upper portion of the lip of any orchidaceous plant when this organ is divided into two parts which are dissimilar in appearance.

EPICHIREMA, n. *ĕp-ĭ-kī-rē'ma* [Gr. *epicheireō*, I attempt; I put my hand to; *epi*, upon; *cheir*, the hand]: in rhet. and logic, syllogism in which the proof of the major or minor premise, or both, is introduced with the premises themselves, and the conclusion is drawn in the usual way.

EPICHLORHYDRIN, n. *ĕp-ĭ-klōr hī'drīn* [Gr. *epi*, upon; Eng. *chlorhydrins*]: in chem., glycidic hydrochloride, C_3H_5ClO , or $O < \begin{matrix} CH_2 \\ | \\ CH \end{matrix}$

CH_2Cl . It is isomeric with mono-chloracetone, $CH_2Cl\cdot O\cdot CH_3$. Epichlorhydrin is obtained by adding finely powdered caustic soda slowly to dichlorhydrin, but the temperature must not rise above 130° . Then it is distilled. E. is a colorless liquid insoluble in water; it boils at 117° ; soluble in alcohol and in ether. It unites with fuming hydrochloric acid, forming symmetrical dichlorhydrin, $CH_2Cl\cdot CH(OH)\cdot CH_2Cl$. By long boiling with water it is converted into monochlorhydrin. Nitric acid converts it into chlor-lactic acid, $CH_2Cl\cdot CH(OH)\cdot CO\cdot OH$.

EPICHLORITE, n. *ĕp-ĭ-klōr'īt* [Gr. *epi*, upon, over, with; Eng. *chlorite*: named to suggest that it is allied to chlorite]: dull green mineral with a white or greenish streak, and greasy lustre. It occurs fibrous or columnar. Found at Harzburg.

EPICLINE, n. *ĕp'ĭ-klin* [Gr. *epi*, upon; *klinē*, a bed]: in bot., the nectary when placed on the receptacle of the flower. EPICLINAL, a. *ĕp'ĭ-kli'năl*, seated on the disk or receptacle.

EPICOLIC, a. *ĕp-ĭ-kōl'īk* [Gr. *epi*, upon; *kōlon*, the colon]: in anat., the colon; pertaining to the part of the abdomen so situated.

EPICOROLLINE, n. *ĕp'ĭ-kōr'ōl-līn* [Gr. *epi*, upon; Eng. *corolline*]: in bot., inserted upon the *corolla*.

EPICRANIUM—EPICURE.

EPICRANIUM, n. *ĕp'i-kra'ni-ŭm* [Gr. *epi*, upon; *kra-nion*, the skull]: the scalp or integuments lying over the cranium. EPICRANIAL, a. *ĕp'i-kra'ni-ăl*, applied to the muscle which extends over the upper surface of the cranium uniformly from side to side, without division.

PICTETIAN, a. *ĕ-pik-tē'shi-an*: of or relating to Epicetus.

PICTETUS, *ĕp-ik-tē'tūs*: celebrated philosopher, disciple of the Stoic; b. Hierapolis, in Phrygia, about A.D. 50. He was at first the slave of Epaphroditus, a freedman of Nero, at Rome, whose abusive treatment he is said to have endured with the composure characteristic of the sect to which he belonged. He was afterward manumitted, and applied himself to the Stoic philosophy. Domitian hated him on account of his principles, and banished him along with several other philosophers, from Rome. E. settled at Nikopolis, in Epirus. Under the pressure of the times in which he lived, his serious moral views received a character rather of self-denial than of energy; to renounce, to endure, and not to set the mind upon anything beyond the power of the individual to attain, being the points chiefly insisted on. His pupil, Arrianus, collected the maxims of E. in the work entitled *Encheiridion* ('Handbook') and in eight books of Commentaries, four of which are lost. The peculiar excellence of the writings of E. consists in their simple and noble earnestness. That real heartfelt love of good and hatred of evil which we associate with Christian feeling, manifests itself very finely and beautifully in these; though, as Prof. Brandis says, 'there is not a trace in the *Epictetea* to show that he was acquainted with Christianity, and still less that he had adopted Christianity, either in part or entirely.' Some of his opinions, moreover, are essentially Christian in their nature, though, of course, they are unconnected with the facts of revelation. E. believes in our 'resemblance' to God, in our 'relationship' to him, and in our 'union' with him through the coincidence of the 'will' and the 'soul'; he recognizes the contest between good and evil, the life-struggle in the heart, the divine life against which the law in the members wars; and he affirms the necessity of 'invoking God's assistance in the strife,' that the inner life may become pure as God is pure. There are several good editions of the works of E.; the most complete is that of Schweighäuser (Leip. 1800).

EPICURE, n. *ĕp'i-kūr* [L. *Epicūrus*; Gr. *Epíkouros*, Epicurus, a famous Greek philosopher, to whom is ascribed, but erroneously, the teaching that 'pleasure is the highest good']: a man who indulges in the luxuries of the table; a dainty eater. EPICUREAN, a. *-kū-rē'ān*, luxurious: N. a disciple of Epicurus. EPICURISM, n. *-rīz-m*, luxury; habits of gross indulgence. EPICUREANISM, n. *-rē'ān-īz-m*, or *-kū'rē-ān-īz-m*, the doctrines of Epicurus. EPICURIZE, v. *-rīz*, to become an epicure; to play the epicure. EPICURING, imp.: ADJ. tending toward the doctrines of Epicurus.—SYN. of 'epicure': gourmand; voluptuary; sensualist.

EPICURUS.

EPICURUS, ēp-ĕ-kū'rūs—**EPICUREANISM**, ēp-ĕ-kū'rē-an-izm, or -rē'an-izm: an illustrious Greek philosopher, and his system. EPICURUS: b.c. 341—b.c. 270; b. in the island of Samos, seven years after the death of Plato. His father, Neocles, is said to have been a schoolmaster, and his mother, Chœrestrate, to have practiced arts of magic. At the age of 18, he went to Athens, where it has been supposed that he may have had for his teacher Xenocrates or Theophrastus, or perhaps both, but he himself used to declare that he was self-taught. Of the older philosophers, he was most attached to Anaxagoras and Democritus, his system of physics being evidently built upon the atomic speculations of the latter. E.'s stay at Athens on this occasion was short. At Mitylene, in his 32d year, he first opened a school; and there and at Lampsacus he taught for five years. In b.c. 306, he returned to Athens, and established a school of philosophy in a garden which he purchased and laid out for the purpose. From this circumstance, his followers were called the 'philosophers of the garden.' Although E. laid down the doctrine, that *pleasure* is the chief good, the life that he and his friends led was one of the greatest temperance and simplicity. They were content, we are told, with a small cup of light wine, and all the rest of their drink was water; and an inscription over the gate promised to those who might wish to enter no better fare than barley-eakes and water. The chastity of E. was so incontestable, that Chrysippus, one of his principal opponents, in order to deprive him of all merit on the score of it, ascribed it to his being without passions. The calumnies which the Stoics circulated concerning him are undeserving of notice, and were at no time generally believed. E.'s success as a teacher was signal; great numbers flocked to his school from all parts of Greece, and from Asia Minor, most of whom became warmly attached to their master, as well as to his doctrines, for E. seems to have been characterized not less by amiability and benevolence than by force of intellect. He died in the seventy-second year of his age.

E. was a most voluminous writer. According to Diogenes Laertius, he left 300 volumes. Among others, were 37 books on Natural Philosophy, a treatise on Atoms and the Vacuum; one on Love; one on Choice and Avoidance; another on the Chief Good; four essays on Lives; one on Sight; one on Touch; another on Images; another on Justice and the other Virtues, etc. Almost all these works are lost: the only writings of E. that have come down to us are three letters, and a number of detached sentences or sayings, preserved by Diogenes Laertius, in his life of the philosopher. The principal sources of our knowledge of the doctrines of E., besides the above letters, etc., are Cicero, Seneca, and, above all, Lucretius, whose great poem, *De Rerum Natura*, contains substantially the Epicurean philosophy.

Although the majority of E.'s writings referred to *natural* philosophy, yet he was not a *physicist*, properly speaking. He studied nature with a *moral* rather than with a

EPICURUS.

scientific design. According to him, the great evil that afflicted men—the incubus on human happiness—was FEAR; fear of the gods and fear of death. To get rid of these two fears, was the ultimate aim of all his speculations on nature.

The following is a brief account of his views. E. regarded the universe (*Tō Pān*) as corporeal, and as infinite in extent, and eternal in duration. He recognized two kinds of existence—that of bodies, and that of *vacuum*, or space, or the intangible nature. Of his bodies, some are compounds, and some atoms or indivisible elements, out of which the compounds are formed. The world, as we now see it, is produced by the collision and whirling together of these atoms. He also held the doctrine of perception by *images* (Gr. *eidōla*) which are incessantly streaming off from the surface of all bodies, and which are necessary to bring us into *rapport* with the world without. In like manner, he believed that sounding bodies threw off emanations, by which we are brought into sympathy with them; and that perception by smell took place in the same way. In psychology, E. was a decided materialist, holding, for various reasons, that the soul is a bodily substance, composed of subtle particles, disseminated through the whole frame, and having a great resemblance to spirit or breath with a mixture of heat.

In seeking to understand the phenomena of the heavens, E. has no scientific end in view; his sole object is to enable the mind to account for them to itself, without the necessity of imagining any supernatural agency at work. ‘The phenomena of the heavens,’ says E., ‘admit of various causes being assigned for their production, equally conformable to the facts learned from the senses. If, then, in thinking of any appearance, we suppose it brought about by the same cause that produces another appearance which gives no alarm or uneasiness, we are as much delivered from uneasiness as if we *saw* that such is the cause of it.’ E. did not deny that there are gods, but he strenuously maintained, that as ‘happy and imperishable beings,’ they could have nothing to do with the affairs of the universe or of men. ‘Beware,’ he says, ‘of attributing the revolutions of the heaven and eclipses, and the rising and setting of stars, either to the original contrivance or continued regulation of such a being. For business, and cares, and anger, and benevolence, are not accordant with happiness, but arise from weakness, and fear, and dependence on others.’

E. next proceeds to deal with the fear of death. Having proved in his psychology that the dissolution of the body involves that of the soul, he argues that the most terrible of all evils, death, is nothing to us, ‘since *when we are, death is not; and when death is, we are not*. It is nothing, then, to the dead or the living; for to the one class it is not near, and the other class are no longer in existence.’ Whether E. actually succeeded in removing the terrors of death by his syllogism, may be doubted.

As to the *positive* part of E.’s system, he held that *pleasure*

EPICYCLE.

was the chief good, and it is from a misapprehension of the meaning of this word as used by E. that the term Epicurean came to signify one who indulged his sensual appetites without stint or measure. At the same time, it is easy to see that the use of the word ' pleasure ' was likely to produce the mischievous results with which the later Epicureanism was charged. According to E. the sources and tests of all ethical truth are the feelings (*pathē*), and these are two, pleasure and pain. ' We delight in the one, and avoid the other instinctively. ' When we say that pleasure is the end of life, we do not mean the pleasures of the debauchee or the sensualist, as some from ignorance or from malignity represent, but freedom of the body from pain, and of the soul from anxiety. For it is not continuous drinkings and revellings, nor the society of women, nor rare viands, and other luxuries of the table, that constitute a pleasant life, but sober contemplation that searches out the grounds of choice and avoidance, and banishes those chimeras that harass the mind.' But, on the other hand, E. says : ' If the means to which sensualists owe their pleasures dispelled the anxieties of the mind and enabled them to set limits to their desires, we should have no grounds to blame them for taking their fill of pleasure, wherever they could find it, provided it were attended with no pain or grief from any quarter; for that is the only evil.' The whole question of ethics, then, comes to a calculation and balancing of pleasures and pains; in other words, the cardinal virtue is a selfish *prudence*. E. rests *justice* on the same prudential basis as temperance. Denying any abstract and eternal right and wrong, he affirms that injustice is an evil, because it exposes the individual to disquietude from other men; justice is a virtue, because it secures him from this disquietude. ' Injustice is not an evil in itself, but becomes so from the fear that haunts the injurer of not being able to escape the appointed avengers of such acts.' The duties of friendship and good-fellowship are inculcated on the same grounds of security to the individual.

Among the Romans, the system of E. was adopted by many distinguished men. Horace, Atticus, and Pliny the Younger, were Epicureans; and the splendid poem of Lucretius must have recommended the system to many. In modern times, Epicureanism was resuscitated in France by Pierre Gassendi, who published an account of E.'s life and a defense of his character 1647. Many eminent Frenchmen have professed his principles; among others, Molière, Saint Evremond, Count de Grammont, the Duke of Rochefoucauld, Rousseau, Fontenelle, and Voltaire; and his system has doubtless never lacked practical development in all lands.

EPICYCLE, n. *ĕp'ī-sī'kl* [Gr. *epi*, upon; *kuklos*, a circle]: a little circle whose centre is on the circumference of a greater circle. The earlier astronomers assumed that all the motions of heavenly bodies took place in circles, the circle being held to be the most *perfect* of all curves; and a necessary consequence of this assumption was, that the mo-

EPIDAMNUS.

tions must have a uniform velocity. Another part of the hypothesis was, that all the heavenly bodies moved round the earth, which remained at rest in the centre. The observed phenomena of the heavens, however, were soon seen to stand in glaring inconsistency with these assumptions; and to remedy this, it was necessary to have recourse to additional assumptions. For the sun and moon, which manifestly do not always move with the same velocity, the *Eccentric Circle* was imagined. The case of the planets, whose motions were seen to be sometimes direct, sometimes retrograde, and sometimes altogether arrested, offered still greater difficulties; to surmount which, the idea of *epicycles* was hit upon. According to this hypothesis, while a planet was moving in a small circle, the centre of that small circle was describing a larger circle about the earth. This larger circle was called the *deferent*, and the smaller, which was borne upon it, was called the *epicycle*. In this way the motions of the planets about the earth were conceived to be something like what the motion of the moon about the sun actually is. By assuming proper proportions between the radii of the deferent circle and the epicycle, and between the velocities of the two motions, it was found possible to account approximately for the above-mentioned appearances and irregularities in the motions of the planets. But it is only the irregularities arising from the revolution of the earth about the sun that can be at all explained in this way, and not those arising from the elliptic motions of the planets about the sun, nor the inequalities of the moon's motions. The successors of the Greek astronomers, down to Tycho Brahé, continued, therefore, to increase the number of epicycles, setting one circle upon another, until the hypothesis, in itself complicated, became still more so, filling the heavens with a mazy dance of stars, in striking contrast to the simplicity of the Copernican system.

EP'ICY'CLOID, n. *-kloyd* [Gr. *eidos*, form]: peculiar curve described by a point in the circumference of one circle when moving over the convex or concave part of the circumference of another. When a circle moves upon a straight line, any point in its circumference describes a cycloid (q.v.); but if the circle move on the convex circumference of another circle (i.e. if the circle be an epicycle), every point in the plane of the first circle describes an epicycloid; and if on the concave circumference, a hypocycloid. The circle that moves is the generating circle; the other, the base. The describing point is not necessarily in the circumference of the generating circle, but may be anywhere in a radius or its prolongation. This curve was investigated first by the Danish astronomer Römer. It has many remarkable properties, and is even useful in the practical arts. The teeth of wheels in machinery must have an epicycloidal form, in order to secure uniformity of movement.

EP'ICYCLOID'AL, a. pertaining to.

EPICYCLOIDAL WHEEL, a wheel for converting circular into alternate motion, or the reverse.

EPIDAM'NUS: see DURAZZO.

EPIDAURUS—EPIDEMIC.

EPIDAURUS, ēp'-i-daw'rūs: town of ancient Greece, on the e. shore of the Peloponnesus, in the district of Argolis, on a small promontory, 15 stadia in circumference, in the Saronic Gulf; lat. $37^{\circ} 38' \text{ n.}$, long. $23^{\circ} 10' \text{ e.}$ During the most prosperous period of Grecian history, E. was an independent state. It was colonized first, it is supposed, by Carians (hence the older name of *Epicarus*, according to Aristotle), and afterward by Ionians, but was subsequently invaded by a Dorian army under Deiphontes, son-in-law of Temenus the Heracleide. This force dethroned Pityreus, the Ionian king of E., compelled him and his citizens to retire to Athens, and inaugurated the Dorian rule, which preserved the ascendancy at E. during the whole historical period. The form of government was originally monarchical, but after many vicissitudes, it eventually became and remained oligarchical. At an early period, E. became one of the chief commercial cities of the Peloponnesus. It colonized the islands of Cos, Calydnus, and Nisyrus, as well as the town of Ægina, which, during the 6th c., attracted all the commerce from the then declining mother-city. E. was famous chiefly for its temple of Æsculapius, to which patients resorted from all parts of the Hellenic world, seeking cures. The site of this temple was a plain surrounded by mountains, about 5 m. w. of the town, and which is still called Hieron, the sanctuary. E. had also numerous temples, among which were those of Artemis, Dionysus, Aphrodite, and Hera, and a magnificent theatre, at present in a more perfect state of preservation than any in the Peloponnesus, and with sufficient accommodation for 12,000 spectators.

E. (modern Greek, *Epidavro*) is now a small village, with scarcely 100 inhabitants, employed for the most part in raising vegetables for the Athenian market. The plain surrounding the village is productive and highly cultivated. Here, 1822, Jan., a congress from all parts of Greece assembled, and promulgated the constitution, known as the constitution of Epidaurus.

EPIDEICTIC, a. ēp'-i-dīk'tīk, or **EPIDEIC'TICAL**, a. -āl [Gr. *epideiknumi*, to show off—from *epi*, and *deiknumi*, to show]: showing off; displaying; specifically, applied to elaborate eulogiums or set orations, such as were frequent among the Athenian orators, and of which Socrates gives the best examples.

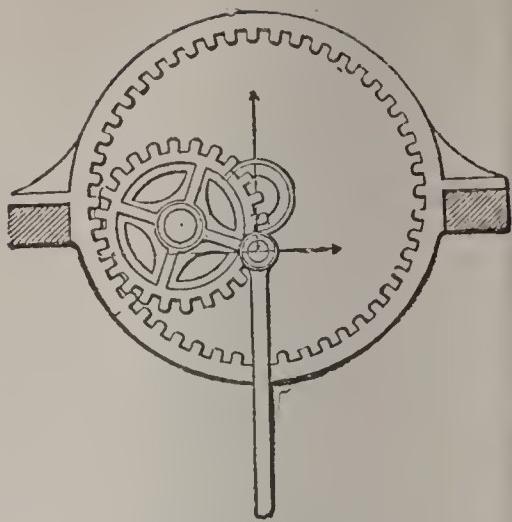
EPIDEMIC, a. ep'i-dēm'īk, or **EP'IDEM'ICAL**, a. -ī-kāl [Gr. *epi*, upon; *dēmōs*, the people: F. *épidémique*]: attacking many persons; prevailing generally; affecting great numbers. An *Epidemic* is a disease which attacks numbers of persons in one place simultaneously or in succession, and which in addition is observed to travel from place to place, often in the direction of the most frequented lines of communication. Many epidemic diseases are also contagious, and all suggest the necessity of careful inquiry into the ventilation, drainage, food, drink, and habits of the persons liable to be affected. See **HEALTH**. **EP'IDEM'I-CALLY**, ad. -ī. **EPIDEMIOLOGY**, n. ēp'i-dēm'ī-ōlōjī [Gr.

PLATE 2.

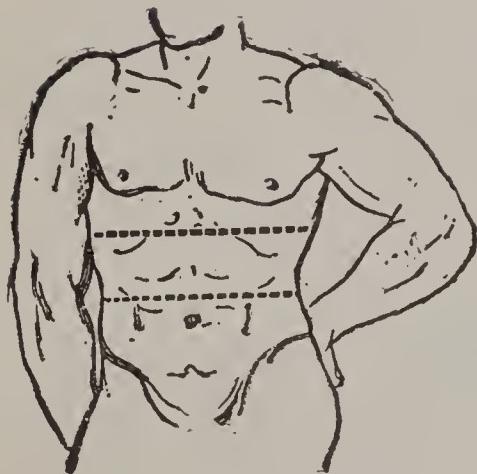
Ephod
Epipactis



Ephod.



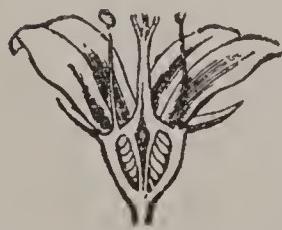
Epicycloidal Wheel.



Epigastrum.



Epiglottis.



Epigynous Stamens of *Philadelphus coronarius*.



Epipactis: 1, Lip; 2, Column.

EPIDEMIC CEREBRAL MENINGITIS.

logos, discourse]: doctrine of epidemic diseases; method of investigating such diseases. EP'IDEM'IOLoGICAL, a.-ō-lōj'i-kāl, connected with or relating to, epidemic diseases. EPIDEMIOGRAPHY, n. ēp-i-dēm-i-ōg'rā-fī [Gr. graphō, I write]: treatise on epidemic diseases. Note.—*Epidemic diseases* are not of a permanent character, are due to contagion, or are carried by the atmosphere, and follow a track more or less wide; whereas *endemic diseases* are connected with certain local conditions, and are more or less permanent in a district. See ENDEMIC: also CONTAGION: INFECTION: FEVER: CHOLERA: ETC.

EPIDEM'IC CER'Ebral MENINGI'TIS: disease noticed and described by many American physicians since 1811, when Dr. North specially drew the attention of the profession to it. In 1838-40, it appeared in France, and committed great ravages in Versailles, where the mortality was 28 per cent.; in Strasburg, where the mortality was 42 per cent.; in Lyon, Nancy, and other garrison towns. The patients, in these cases, were almost entirely young conscripts; and the disease was regarded as non-infectious. In the spring of 1846, it appeared in the Dublin and Belfast workhouses, boys under 12 years of age being the only victims. In 1863, it was very fatal in the United States. In 1865, it ravaged West Prussia: of 2,000 cases recorded, half died; and of 347 cases, 330 were under 14 years of age. In the United States, two forms of the disease are recognized—one marked by shock, weak pulse, purpled limbs, and coma, death happening within the first day; the other presenting signs of cerebro-spinal mischief, such as tetanoid spasms; death here occurred in three days. Purple spots were present in 27 out of 44 cases.

A form of the disease is the *Black Death*, which, 1866, 7, caused intense alarm in Ireland. A healthy medical student, aged 19, residing in Dublin, fell ill with chilliness and *malaise*, 1866, Mar. 18, abt. noon. When he was visited in the evening, it was found that he had vomited frequently and was very prostrate; purple blotches appeared on his skin during the night, and about noon next day, he suddenly fell into stupor, and was dead at two, or about 26 hours from the apparent commencement of the symptoms. A girl, aged 18, presented similar symptoms Apr. 2, but recovered. Fatal cases were recorded May 12, 13. and 17. According to Dr. Mapother, 63 fatal cases had been registered (before July 1) in the Dublin district, exclusive of eight deaths among soldiers. The symptoms include two types of very different severity. In the graver, life is rapidly extinguished as if by a blood-poison; in the milder, the symptoms are those of inflammation of the cerebro-spinal axis, or its membranes. Dr. Stokes, however, regards these latter phenomena as secondary to the essential disease, and believes that they will always appear, if the patient lives long enough for their development. The earliest symptoms are chilliness and a sense of impending danger, and vomiting of a persistent character soon follows. There is constipation till shortly before death, when the evacua-

EPIDEMIC MENTAL DISEASES.

tions are involuntarily discharged. The tongue is dry; the pulse abnormally compressible, and usually over 100. The dark purple blotches, caused by the escape of dissolved hematin (coloring matter of the blood) from the smaller vessels, are situated in and under the true skin of the legs, hands, face, back, and neck. These patches vary in size from that of a pin's head to that of a walnut, and are often sufficiently raised to be detected by the touch. The skin is dusky and moist, sometimes even bathed in sweat. In some cases, stupor, and in others, delirium and intense restlessness, are the forerunners of death. The rapidity with which this disease runs its course is appalling. A healthy boy, aged $10\frac{1}{2}$ years, sank in less than five hours from the time of his seizure; and of 41 investigated fatal cases, 14 terminated within 24 hours. Of these cases, 21 were females, 20 males. Youth predisposes very strongly to the disease. No position in life affords exemption; one young nobleman, three medical students, two undergraduates, and several inhabitants of the lowest hovels—the seats of typhus and cholera—were among the victims.

With regard to treatment, almost every kind has been tried, and each has been found equally unavailing. The external application of cold to the spine and head, as advocated in various forms of disease by Dr. Chapman, deserves a trial. Dr. Mapother suggests that the disease is due, like scurvy, to the want of fresh vegetables as an article of food; and if this view is correct, this terrible malady is preventable. See MENINGITIS.

EPIDEMIC MENTAL DISEASES: morbid states of mind pervading a community. When we consider how ordinary and normal thoughts and emotions spread from one man to many, and sway multitudes to the same views and actions, we are not surprised at mental epidemics—such as, at times, spread from man to man, and involve whole nations. Such a disorder depends for its propagation, like physical epidemics, first on external circumstances, secondly, on the peculiar condition or constitution of the individuals affected. Like the bodily affection, the causes which provoke the insanity and the tendency to be affected may have been in process of development for years. Both attack the weak rather than the strong; both exist for a season, and disappear. In the case of the mental malady, the external influences—those which constitute the moral atmosphere—are ignorance, the power of one mind over another, the influence of language, the diffusion of particular opinions, the tendency to imitate. Probably, physical causes also are greatly efficient. In 1842 and 44, there occurred in Germany and France, among the military, epidemics of meningitis with delirium, or inflammation of the membranes of the brain, when no moral factors were at work, but when diet, temperature, etc. were. But even where the origin cannot be so distinctly traced, the co-operation of external as well as moral and psychical agencies may be legitimately predicated. It would accordingly be illogical to limit the production of the dancing

EPIDENDREÆ.

mania (q.v.), which occasionally, during several centuries, swept over Europe, to the reaction succeeding the dread of the end of the world, which had previously prevailed epidemically. An examination of about a hundred manifestations such as that alluded to, collected from various sources, demonstrates that not merely the intoxication of joy, but the most absurd forms of belief—that dreams, delusions, superstitions, corruptions of language, all instincts and passions, even movements and cries—may assume the form, and to a certain extent follow the laws of epidemic disease. From distant ages, there are records of a histrionic plague, when, after a summer of intense heat, multitudes conceived themselves players, and traversed the streets, and sank and died, repeating verses, and exhibiting extravagant gesticulations; of whole communities stricken with nightmare, which was so general as to be deemed contagious. There have been epidemics of homicidal and suicidal mania. In one age, hundreds were found possessed by Satan so far at least as their own belief and behavior went; in another, larger numbers supposing themselves changed into wolves; and in recent times, the leaping ague of Forfarshire, and outbursts of pyromania in various places, remind us of Bp. Butler's question: What is to prevent a whole nation becoming mad? The instances of epidemic mental disease recorded in the following table, have been selected from a vast number, with a view of showing not the frequency or extent of such affection, but the range of the phenomenon through the powers and propensities of our nature.

Popular Name.	Form of Disease.	Year.	Number Affected.	Authority.
St. Vitus's Dance....	Choreomania...	1374	Hundreds	Hecker
St. John's Dance....		1523	"	Calmiel
Wolf-madness.....	Lycanthropia...		"	"
Possession	Demonomania..	1642, etc.	"	
Convulsionaries of St. Medard.....	Theomania.....	1731	"	"
Ineendiariasm	Pyromania.....	1800	Many	Marc
Witchcraft.....	Deimonopathia..	Various	Thousands	Various
Suicide.....	Melancholia....	"	"	Esquierol
Visions.....	Delusions	"	Many	Brierde
Timoria, Panic.....	Panphobia.....	1845	Many	Boismont
				{ Edin. Review 1849}

There appears to be no guarantee that the present and future generations shall be exempted from similar visitations, except in the general establishment of soundness of body and spirit.—Hecker's *Epidemics of the Middle Ages*; Calmiel, *De la Folie considérée sous le Point de Vue Pathologique, Philosophique, Historique et Judiciaire, depuis la Renaissance des Sciences en Europe jusqu'au dixneuvième Siècle*, etc., and *Psychological Journal*, *passim*.

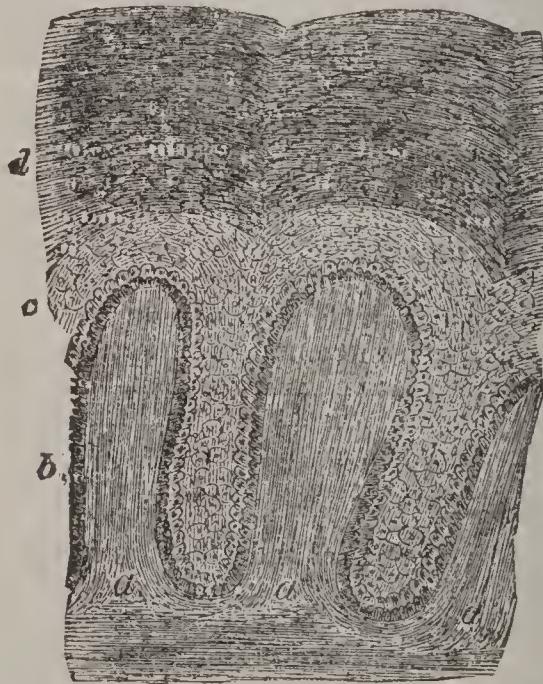
EPIDENDREÆ, n. ēp-ē-dēn'drē-ē: tribe of orchids. It comprises those genera which have the pollen masses waxy; a distinct candide, but no separate stigmatic gland. EPIDENDRUM, n. -drūm [Gr. *epidendrios*, on or in a tree—from *epi*, upon; *dendron*, a tree]: general term for an orchid of whatever genus growing on trees; an epiphytal

EPIDERMIC.

orchid. *Epidendrum* is the name of a large genus of S. American orchids, family *Læliadæ*, and the typical genus of the tribe *Epidendree*. More than 300 species are known, most of them epiphytal on trees, but some terrestrial. Many are beautiful, especially *E. nemorale*. *E. bifidum* is said to be purgative, anthelmintic, and diuretic. Two specimens are found in the United States: *E. conopseum*, on magnolia trees in S. C., Ga., and Fla.; and *E. venosum*, in Fla.

EPIDERMIC, a. *ep'i-dér'mik* [Gr. *epi*, upon; *derma*, skin] pertaining to the outer skin or cuticle; also EP'IDER'MAL, a. -*dér'mál*. EP'IDER'MIS, n. -*mís*, or EPIDERM, outer skin of the body; the cuticle; the outer coating of a plant or tree. In the body, it is a semi-transparent membrane, containing neither vessels nor nerves, and everywhere forming an external covering to the corium or true skin: see SKIN. The epidermis is called in ordinary language the *scarf-skin*. It consists of two layers, chemically and morphologically distinct—the *mucous layer*, which lies immediately upon the corium, and the *horny layer*, which forms the outermost surface of the body.

The *mucous layer* (known formerly as the *rete mucosum s. Malpighianum*) is of a whitish or slightly brown tint (in the Negro, dark gray or black), and is composed of small soft cells. The innermost of these cells, resting on the



Perpendicular Section of the Skin of the Leg of a Negro: Magnified 250 diameters.

a, *a*, papillæ of the cutis; *b*, deepest intensely colored layer of perpendicularly elongated cells of the mucous layer; *c*, upper stratum of the same layer; *d*, horny layer.

surface of the corium, are elongated and arranged perpendicularly; upon these follow elongated or roundish cells in many layers, which, in proportion to their distance from the corium, acquire, from their mutual pressure, a polygonal form, which may even be recognized in individual cells.

EPIDERMIC.

All the cells in the mucous layer are nucleated vesicles distended with fluid, and likewise containing minute granules, which diminish in number in the more external cells.

The *horny layer*, the external semi-transparent part of the epidermis, in the white races is colorless; it is composed almost wholly of uniform cells, metamorphosed into plates or scales. The deepest plates in some degree resemble the uppermost cells of the mucous layer; but in the second or third layer the flattening begins; till at length, after a gradual series of modifications, the hard, horny scales occur on the surface, where they are regularly cast off with more or less rapidity, and replaced by those beneath them. In reptiles and amphibians, this layer is periodically cast off in a more or less entire state, a new one being previously formed beneath it; and in man, desquamation in large patches often occurs after certain diseases, especially scarlatina.

The color of the epidermis differs in different persons and in different parts of the body. It is deepest around the nipple, especially in women during pregnancy and after they have borne children. A more or less dark pigment is often deposited, in persons who are exposed to the sun, in the face, neck, back of the hands, etc. These tints are not produced by special pigment-cells, but are seated in the common cells of the mucous layer, round whose nuclei granular pigment is deposited. In the Negro and the other colored races, it is also only the epidermis which is colored, while the *corium* completely resembles that of European races. The perpendicular cells (see *b* in the figure) are the darkest, and form a sharply marked fringe at the edge of the clear corium. To these succeed brown cells, which accumulate in the depressions between the pupillæ, and the approach to the horny layer shows yellowish cells. The horny layer of the Negro also inclines to a yellow or brownish tint.

Morbid coloration of the epidermis (freckles, mother's marks, etc.) is produced in the same way as the color of the Negro's skin. Numerous instances are on record, of partially or entirely white Negroes and of black Europeans, not as a consequence of change of climate but as an abnormal condition of the skin.

The thickness of the epidermis varies extremely. While on the cheeks, brow, and eyelids, it varies from $\frac{1}{75}$ th to $\frac{1}{50}$ th of a line, on the palm of the hand it ranges from $\frac{1}{3}$ d to $\frac{1}{2}$ a line, and on the sole of the foot sometimes even exceeds a line. In some parts of the body the horny layer is thicker than the mucous; in others, the mucous is the thicker of the two. As the chief use of the epidermis is for protection to the soft and tender subjacent parts, it attains its greatest thickness on those portions of the body (palm of the hand and sole of the foot) most exposed to pressure and friction.

In *plants*, as in animals, the epidermis is formed of flattened cells, of which also new layers are continually produced from the bark below, while the outer ones dry up,

EPIDOSYTE—*EPIGÆOUS.*

lose their vitality, and peel off, crack and split off, or otherwise become separated from the living organism. The cells of the epidermis are often enlarged outward, so as to form projections, sometimes very slight, sometimes elongated into hairs (q.v.). Glands (q.v.) also are connected with the epidermis, sometimes by the intervention of hairs, sometimes without, and in this way it contributes to the secretion of substances formed in plants by the wonderful chemistry of nature, and on which their value to man often greatly depends. The cells of the epidermis are usually filled with a colorless fluid, but resinous and waxy substances are sometimes found in them, and sometimes silica (as in grasses and *Equisetaceæ*), sometimes carbonate of lime (as in the *Charas*). The epidermis is pierced by *stomata* (q.v.). When the epidermis of plants is subjected to prolonged maceration, it can often be made to separate into two parts; one, more strictly called the epidermis, being the inner, lower, and thicker membrane; the other, the *Pellicle* or *Cuticle*, being very thin, and extending continuously over every part of the plant except where it is pierced by the stomata. Thus, this superficial pellicle invests even the finest hairs. In some of the *Algæ*, it seems to constitute the whole integument. In the greater number of plants, the epidermis is thin and soft, but sometimes it is thick, and sometimes hard.

EPIDOSYTE, n. *ēp'-i-dō'sīt* [Gr. *epidosis*, a giving over and above; increase]: rock consisting, in 100 parts, of 61·33 epidote and 38·22 quartz. It is found in parts of Canada.

EPIDOTE, n. *ēp'i-dōt* [Gr. *epi*, upon; *didōmai*, I give or add to; *didōtai*, it gives or adds to]: mineral allied to garnet, composed of silica and alumina, with a considerable proportion of lime, or of peroxide of iron, or of peroxide of manganese. These diversities of composition constitute three very distinct varieties; and of these there are sub-varieties, differing in color and other particulars (*Pistacite*, *Bucklandite*, *Withamite*, *Zoisite*, etc.). E. is found sometimes massive, foliated, columnar, granular, or incrusting; often crystallized. Its crystals are prisms, variously modified. Its prevalent colors are green, yellow, and gray, but some varieties are red and black. It is found in gneiss, syenite, trap, and other rocks in many parts of the world.

EPIGÆA REPENS, *ēp'-i-jē'a rēp'ēnz* (TRAILING ARBUTUS, or MAYFLOWER): one of the earliest spring flowers in the United States, belongs to the *Ericaceæ*, and is prized for its beauty and fragrance. It is indigenous to the n.e. states, along the Atlantic coast line, and the interior of Conn., Mich., Wis., Minn., and several of the s. states, where it is known as ground laurel; and medically is a strong diuretic. The pilgrim settlers found it abundant in the Plymouth woods, a welcome harbinger of spring before all the snow of their first dreary winter had gone.

EPIGÆOUS, a. *ēp'-i-jē'ūs* [Gr. *epi*, upon; *gē*, the earth]: in bot., growing on land in contradistinction to growing in the water; growing close to the earth. **EPIGE'AL**, a. *-jē'āl*, above ground.

EPIGEE—EPIGONATION.

EPIGEE, n. *ĕp'ĕ-jĕ* [Gr. *epi*, upon; *gē*, the earth]: the point of a planet's or satellite's orbit nearest to its primary: same as PERIGEE, which see.

EPIGENE, a. *ĕp'ĕ-jĕn* [Gr. *epi*, upon; *gennaō*, I produce]: in *mineral.*, having undergone alteration in its chemical character while retaining the same crystalline form as before, foreign to the position which the crystals at present occupy; pseudomorphic.—In *geol.*, E. signifies originating on the surface of the earth, as distinguished from hypogene rocks like granite, of which Lyell's hypothesis is that it originated at a considerable depth below the surface.

EPIGENESIS, n. *ĕp'ĕ-jĕn'ĕ-sis* [Gr. *epi*, upon; *genēsis*, generation]: formation upon, or in addition to, previously existing parts. The word is applied in physiology to that theory of new formations in organized beings which supposes them to spring from superadded centres of vital activity, as opposed to the theory which presumes that the new is formed by an evolution or development or modification of the old structure. See REPRODUCTION.

EPIGENOUS, a. *ĕ-pi'jĕn-ūs* [Gr. *epigenēs*, in class. Gr. growing after or late, but here used for growing upon living bodies: *epi*, upon; *genos*, race, stock (?)]: in *bot.*, growing upon the surface of a plant, or part of it. Thus many fungals grow on the leaves of plants.

EPIGEOUS, or EPIGÆUS, n. *ĕp'ĕ-jĕ'ūs* [Gr. *epigeios*, on or of the earth; *epi*, upon; *gē*, the earth]: in *bot.*, living close upon the earth.

EPIGLAUBITE, n. *ĕp'ĕ-glaw'bīt*: in *min.*, variety of metabrushite (q.v.).

PIGLOTTIS, n. *ĕp'ĕ-glōt'tīs* [Gr. *epi*, upon; *glottis*, the mouth of the windpipe—from *glotta*, the tongue]: the valve or cartilage that covers the upper part of the windpipe when food or drink is passing into the stomach: see LARYNX.

EP'IGLOT'TIC, a. -*glōt'tīk*, pertaining to.

EPIGÆA REPENS, *ĕp'ĕ-jĕ'a rĕp'ĕnz* (TRAILING ARBUTUS, or MAYFLOWER): one of the earliest spring flowers in the United States, belongs to the *Ericaceæ*, and is prized for its beauty and fragrance. It is indigenous to the n.e. states, along the Atlantic coast line, and the interior of Conn., Mich., Wis., Minn., and several of the s. states, where it is known as ground laurel; and medically is a strong diuretic. The pilgrim settlers found it abundant in the Plymouth woods, a welcome harbinger of spring before all the snow of their first dreary winter had gone.

EPIGONATION, n. *ĕp'ĕ-go-nā'tī-ōn* [Gr. *epigonatis*, the kneepan, also a garment reaching to the knees;—from *epi*, upon; *gonatos*, the knee]: lozenge-shaped piece of some stiff material, which forms part of the dress of bishops in the Greek Church while officiating. It hangs from the girdle on the right side as low as the knee, and is supposed to represent the napkin with which our Lord girded himself at the Last Supper.

EPIGONE—EPIHYAL.

EPIGONE, n. *ě-pǐg'ō-nē* [Gr. *epi*, upon; *gōnē*, the seed, offspring]: in *bot.*, the cellular layer which covers the young seed-case in mosses, etc.

EPIGONI, n. plu. *ě-pǐg'ō-nī* [Gr. *epi*, upon; *gōnē*, seed, offspring]: those after-born; a mixed race; particularly applied to the children of the soldiers of Alexander the Great by Asiatic women.

EPIGRAM, n. *ěp'i-grām* [F. *épigramme*—from L. *epigramma*, an inscription—from Gr. *epi*, upon; *gramma*, a writing]: very short poem on one subject ending with a witty or ingenious turn of thought; the epigrams of the Greeks were simply inscriptions in verse on tombs, statues, and monuments, marked by great simplicity of style, but having little in common with what now passes under the name. It was among the Romans that the epigram first assumed a satirical character. Catullus and Martial are reckoned the best Latin epigrammatists. In modern times, an epigram is understood to be a very short poem, generally two to eight lines, expressing an ingenious thought in pointed phraseology, usually reserving the essence of the wit to the close, as the serpent is fabled to carry its sting in its tail. The French excel all other nations in this kind of poetry. Their earliest epigrammatist of any note was Clement Marot (1495–1544); their best are Boileau, Voltaire, and Firon. The epigrams of German writers are for the most part happily expressed moral proverbs, but the *Xenien* of Schiller and Goethe contain not a few sharp and biting verses of a satirical character. In Britain, Pope, Burns, Byron, Moore, and other writers have shown remarkable power of epigrammatic satire. EP'IGRAMMAT'IC, a. *-māt'ik*, or EP'IGRAMMAT'ICAL, a. *-i-kāl*, like an epigram; concise; pointed (not necessarily always in verse). EP'IGRAM'MATIST, n. *-grām'mā-tīst*, a writer of epigrams. EP'IGRAMMAT'ICALLY, ad. *-lī*.

EPGRAPH, n. *ěp'i-grāf* [F. *épigraphe*—from Gr. *epi*, upon; *graphō*, I write]: in *architecture*, a terse inscription on a monument or other building, to denote their use or appropriation—frequently wrought into the ornamental details of the structure. In *literature*, a citation from some author, or a sentence constructed for the purpose, placed as a motto at the commencement of a book, or at the beginning of each chapter or part. EPIGRAPHIST, n. *ě-pǐg'ra-fīst*, one who studies or is versed in epigraphy. EPIGRAP'HY, n. *-fī*, study of inscriptions; that branch of science which deals with the deciphering and explanation of inscriptions.

EPIGYNOUS, a. *ě-pǐj'i-nūs* [Gr. *epi*, upon; *gynē*, a female]: in *bot.*, having the outer whorls of the flower adhering to the ovary so that their upper portions alone are free, thus appearing to be seated on it.

EPIHYAL, a. *ěp-i-hī'al* [Gr. *epi*, upon; Eng. *hyoid*; suff. *-al*]: pertaining or relating to the stylo-hyoid ligaments: N. constituting part of the lower or visceral arches, inclosing the nose, mouth, and pharynx.

EPILEPSY.

EPILEPSY, n. *ĕp'i-lĕp'si* [Gr. *epilēpsia*, a seizure, the falling sickness—from *epi*, upon; *lambanein*, to take: F. *épilepsie*: L. *epilepsia*: It. *epilessia*]: the falling sickness; a kind of sudden fit, with convulsions. EP'ILEP'TIC, a. *-tĭk*, affected with falling sickness: N. one affected with epilepsy. EP'ILEP'TICAL, a. *-tĭ-kăl*, pertaining to epilepsy.—*Epilepsy* is a form of disease characterized by sudden insensibility, with convulsive movements of the voluntary muscles, and occasionally arrest of the breathing, owing to spasm of the muscles of respiration, and temporary closure of the glottis (q.v.). Epilepsy was called by the ancient Greeks the ‘sacred disease.’ Owing to the mysterious and extraordinary character of the convulsion, it was always, in ancient times, supposed to be due specially to the influence of the gods, or of evil spirits; Hippocrates, however, combats this idea in a treatise, in which he maintains that epilepsy is no more and no less divine than all other diseases. The notion of the specially supernatural character of epilepsy is cognate to the deeply rooted oriental belief of demoniac possession: see DEMONIACS. Epilepsy is often called, in modern language, the ‘falling sickness,’ descriptive of one of its most striking phenomena, and pointing to the most obvious danger of the fit. The patient is seized, without reference to his condition or occupation at the moment, with insensibility, often so complete and sudden as to lead to serious accidents and bodily injuries; in the most aggravated cases, he has no premonitory sensations whatever, but falls down without any attempt to save himself, and usually with a wild inarticulate cry of some kind, immediately after which the face is violently distorted, the head drawn toward one or other shoulder, and the whole body convulsed. These convulsions follow in rapid succession for a few minutes, and are attended by foaming at the mouth, and by great lividity, or, in some cases, livid pallor, which, with the irregular spasmodic movements of the lips, nostrils, and eyes, give a ‘frightfully ghastly’ expression to the countenance, and almost invariably lead the bystanders to an exaggerated idea of the immediate danger of the fit. The immediate danger is, in reality, not great, excepting that the sudden attack may lead to an injurious or fatal fall; the tongue, however, may be bitten if protruded during the convulsion, or the patient may be so placed as to injure himself seriously by the repeated and unconscious movement of his body, or he may suffocate himself by accidentally falling with his face in water, or otherwise closing up the mouth and nostrils, or by dragging upon a tightened neckcloth. Care should be always taken to avoid these accidents by keeping the epileptic as much as possible within view of persons acquainted with his condition, and able to assist him; as well as by warning the patient himself to avoid places of danger. Beyond the obvious precautions indicated above, there is almost nothing to be done for the patient; and any attempt to rouse him by violent stimuli, as ammonia applied to the nostrils, or by dashing water in the face, or, still more, by any internal administration, is likely to do more harm than

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good. The tongue should be looked to, a piece of cork or other gag being, if necessary, inserted between the teeth; the patient should be then placed on a mattress or other soft place near the ground; his neckcloth should be removed, and the dress loosened round the chest; the head should be, if possible, a little raised, and a free circulation of air maintained (this last precaution being apt to be neglected in a crowd). The ordinary course of the fit (which usually lasts five to twenty minutes altogether) is as follows: the convulsions gradually diminish in intensity, and the patient passes into a state of deep but motionless stupor, with dilated pupils, and sometimes, but not always, with snoring or noisy breathing; the foaming at the mouth ceases, the color gradually returns, and this state leads to recovery through a more or less protracted, but apparently natural sleep, the patient, on awaking, being often quite unconscious that he has been the subject of any anxiety, or, indeed, in any unusual condition whatever. Although in all cases of true epilepsy there is a stage of complete coma (q.v.), or unconsciousness, yet the fit is often very transient, and but little attended by convulsion, being also less sudden than above described, and not necessarily causing a fall to the ground; in some cases, also, fits of greater intensity are preceded by certain premonitory symptoms or peculiar sensations, which act as warnings to the patient himself. The French language, popular and scientific, has adopted the terms of *grand mal* and *petit mal* (i.e., great and little evil), as characterizing the more and less dangerous forms of epilepsy respectively. The sensations which precede the fit in some epileptics have been termed in Latin the *aura* (i.e., breath) *epileptica*, from their supposed resemblance to a current of cold air passing over the body, and proceeding from the extremities toward the head. This description does not, however, hold good in all cases; and frequently there is no *aura*, or unusual sensation of any kind, preceding. However, some of the most ancient authorities assert strongly the power of a tight bandage, placed suddenly upon the limb in which the *aura* begins, to cut short, or even to prevent, the fit; and this alleged fact has never been altogether discredited, and has of late years been brought into renewed notice by good observers. It is even maintained by some that such a bandage, placed experimentally upon one or other of the limbs, and tightened on the approach of a fit, has been found effective in some cases in which there was no distinctly local sensation; and epileptics have been repeatedly convinced of the propriety of habitually wearing a bandage loosely applied upon the arm, which they have been able, by carefully watching their own sensations, and by being watched by others, to get tightened at the proper time. If this view be fallacious, there is at least no risking in acting on it.

But the fit and its treatment form only a part of the anxieties which arise out of a case of epilepsy. The ultimate danger of the disease has little relation to the severity of the individual fits; the frequency of the attacks being apparently much more apt than their character to influence

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the duration of life. Indeed, though epileptics may survive several severe paroxysms at distant intervals, and recover in the end with an apparently unbroken constitution, it rarely happens that very frequently repeated attacks, even of the *petit mal*, are unattended by some permanent depreciation of the powers of mind or of body. The most frequent, perhaps, of the serious consequences is insanity (q.v.), sometimes assuming the form of acute mania or monomania following the attacks, but quite as frequently tending to gradual imbecility without any acute seizure. Sometimes the development of the epileptic insanity, or dementia, is attended by palsy, and other indications of structural disorder of the brain; in other instances, no such consequences occur, and the brain after death may be found to have very little tangible disease. Very often, even when the mind remains tolerably entire, there is loss of memory, and a certain want of acuteness and depression of spirits, which unfit the individual for the regular business of life. Disorders of the digestion are also not uncommon; and there is frequently a want of tone and vigor in all the bodily functions, inducing languor and reserve.

The causes and the radical cure of epilepsy are almost equally involved in mystery. It has been supposed by some to be dependent on an increased afflux of blood to the brain; by others it has been attributed, with about equal reason, to precisely the opposite condition. Certain cases undoubtedly depend upon organic disease, as tumors or injuries to the brain and its membranes, more especially near the surface. Local sources of irritation in other parts of the body also have been supposed to be exciting causes; and cases are recorded in which the disease has been cured by the amputation of a finger or the division of a nerve. The attention of recent observers has been especially directed to the medulla oblongata and spinal cord (q.v.), as being the most probable physiological seats of a disease so decidedly marked by convulsive movements. But as yet little more than the most vague theoretical inferences can be drawn from their researches as to the cause of either the epileptic tendency or paroxysm. One of the most suggestive of recent observations is the experiment of Brown-Sequard, showing that epilepsy, or a state closely resembling it, may be induced in certain animals by division of certain portions of the spinal cord, the artificial disease continuing long after the primary effects of the injury have ceased. A still more inexplicable phenomenon has resulted from the multiplication of such experiments; for Brown-Sequard has shown that in guinea-pigs this artificial epilepsy is sometimes propagated to the offspring, becoming, like the natural disease, a hereditary and congenital morbid tendency. On these strange and important facts speculation at present is premature.

The condition of the epileptic seems favorably affected by everything which conduces to a quiet and hopeful state of mind, and to vigor of body. The treatment should therefore in general be of the kind termed *tonic* (q.v.), and should be adapted with care, and after very minute

EPILOBE—EPILOBIUM.

and careful inquiry, to the removal of all special bad habits, and occasional causes of depression of the system. The influence of a happy and quiet domestic life, without unhealthy excitement, and with proper occupations, varied by amusement and exercise in the open air, will tend to prevention of attacks. The marriage of epileptics has been known in some cases to increase the disease, and to involve its transmission to a considerable number of children. Yet a too absolute rule on this subject is not without its dangers. If the tendency exist, even slightly developed, on both sides, marriage must be regarded as in high degree imprudent. Any reserve or concealment on this subject on either side, is a dishonorable deception.

According to one of the oldest and most respected of American physicians (Dr. Jackson of Boston), the epileptic tendency may often be successfully treated by systematic and exclusive vegetable diet, or by large reduction of the proportion of animal food. Among the innumerable remedies recommended by authorities, the salts of iron and zinc have perhaps the largest amount of experience in their favor; and counter-irritants (q.v.) applied to the nape of the neck, or between the shoulders, either by blistering, the use of the seton, or even actual cautery, has often been followed by prolongation of the intervals, or decrease in the severity of the fits. Almost all the accredited remedies, however, have been observed to produce a temporary relief of this kind, even when without any permanent influence on the course of the disease.

Some of the *Lower Animals* are subject to epileptic fits. The disease is common in dogs and highly bred pigs. The creatures writhe with involuntary spasms, and are for the time without sight or hearing. Sometimes the muscles of the throat are so involved that fatal suffocation occurs. The attack is generally preceded by dulness, and lasts 10 to 30 minutes. It is generally traceable to torpidity or irregularity of the bowels, worms, debility, or plethora. In dogs, it is a frequent sequel of distemper. In cattle, it occurs usually in connection with the engorgement of the first or third stomachs; they throw themselves violently about, bellowing loudly, but seldom die. It is rare in horses, and differs from megrims, for which it is often mistaken, but in which there are no spasms. The treatment consists in freely opening the bowels, removing worms, if any are present, resorting to bleeding and spare diet, if the animal's condition is high, and generous feeding and tonics if it is low. The best preventives are carefully regulated diet, an occasional laxative, with a course of tonics, especially of arsenic.

EPILOBE: see EPILOBIUM.

EPILOBEÆ: see EPILOBIUM.

EPILOBIUM, *ɛp-i-lō'bē-ūm*: genus of plants of the nat. ord. *Onagraceæ*, having four deciduous calycine segments; four petals; a much elongated, 4-sided, 4-celled, 4-valved, many-seeded capsule; and seeds tufted with hairs at one end. The species are herbaceous perennials, natives of tem-

EPILOGUE.

perate and cold countries, and very widely diffused both in the n. and in the s. hemisphere. Some are very ornamental from the beauty of their flowers. Most of the Amer. species have small flowers, and some of them are very common in moist places. *E. angustifolium*, which has the



Epilobium Angustifolium:

, a flower; 2, a longitudinal section of a flower, showing the arrangement of the ovules in the germen; 3, a seed.

petals dissimilar in shape and size, is frequently planted in gardens and shrubberies for its numerous and beautiful rose-colored flowers; but its creeping roots are apt to overrun a flower-garden. It is sometimes called FRENCH WILLOW, from the resemblance of its stems and leaves to some kinds of willow, and the name WILLOW-HERB is often extended to the whole genus. It is found in far northern regions, and its leaves and young shoots are sometimes a grateful addition to the meals of the arctic traveller. The pith, when dried, yields a quantity of sugar to boiling water, and is used in Kamtchatka for making a kind of ale, from which also vinegar is made.

EPILOGUE, n. *ép'i-łög* [F. *épilogue*—from L. *epiłögus*: Gr. *epiłogos*, a close or conclusion]: in *oratory*, the summing up or conclusion of a discourse. In connection with the drama, a short speech in prose or verse which frequently, in former times, was subjoined to plays, especially to comedies. The epilogue was always merry and familiar in its tone, and was intended to establish a kindly understanding between the actor and the audience, as well as to conciliate the latter for the faults of the play, if there were any, and to send them away in good-humor. One of the neatest

EPIMACHUS—EPINAL.

and prettiest epilogues ever written, a complete model of what an epilogue should be, is that spoken by Rosalind at the conclusion of Shakespeare's *As You Like It*. **EPILOGISTIC**, a. *ép'i-lō-jis'tik*, of or like epilogue.

EPIMACHUS, *é-pim'a-küs*: genus of birds, natives of Australia and Papua, often improperly classified with birds of paradise. The *E. albres*, of Australia, is of violet-black color, with green-tipped feathers around the neck, and long, white, silky plumes growing from back and rump. The *E. magnus*, of Papua, is of black-brown color, and has a body 12 inches long and a tail 3 ft. long, and a head and belly of beautiful blue.

EPIMEDIUM, n. *ép-i-mē'di-ūm* [L. *epimedion*, a plant, by some supposed to be *Marsilea quadrifolia*: Gr. *epimēdion*, barrenwort]: in bot., barrenwort; genus of berberids, tribe *Nandineae*. *E. alpinum* (Alpine Barrenwort) is found in rock-works, old castle gardens, etc.

EPIMENIDES, *ép-i-mēn'i-dēz*: Greek poet and priest at Crassus; b. probably at Phæstus in Crete, B.C. 6th or 7th c. His history has reached us in only mythical form. He is said to have fallen asleep in a cave when a boy, and not to have wakened for 57 years. Like Rip Van Winkle, he was naturally much astonished and perplexed on his return to broad daylight. His period of slumber, however, had not passed away unprofitably. His soul, disengaging itself from its fleshly prison, betook itself in the interval to the study of medicine and natural philosophy; and when it had taken on again its mortal coil, E. found himself a man of great knowledge and wisdom. Goethe has written a poem on the subject, *Des Epimenides Erwachen*. E. went to Athens about B.C. 596, where, by the performance of various mystical rites and sacrifices, he was said to have stayed a plague with which the inhabitants were afflicted. When he died is not known, but we may be certain that he did not live (as is fabled) 299 years. That he wrote the epic poems attributed to him, the longest of which was on the Argonautic expedition, is highly improbable. Compare Heinrich, *E. aus Kreta* (1801).

EPIMERAL, n. *ép'i mē'rāl* [Gr. *epi*, upon; *mērōs*, the upper part of the thigh]: that part of the segment of an articulate animal which lies immediately above the joint of the limb. **EPIMERA**, n. plu. *é-pim'ē-rā*, the parts lying immediately above the joint of the limb, as the *epimera* or side segments of the lobster.

EPINAL, *ā-pē-nāl'*: town of France, dept. of Vosges, in a delightful district at the w. base of the Vosges Mountains, on both banks of the Moselle, about 200 m. e.s.e. of Paris; lat. $48^{\circ} 10'$ n., long. $6^{\circ} 26'$ e. It is a well-built, handsome town, with clean, regular, though badly paved streets, and is surmounted by the ruins of an old castle, the gardens attached to which are much admired. Among its chief buildings are the parish church, an antique Gothic structure; the hospital, formerly a Capuchin convent; a museum of pictures, antiquities, and natural history; the barracks;

EPINAY—EPIPACTIS.

and the residence of the prefect of the department. E. manufactures chemical products, lace, block-tin, wrought-iron, pottery, cutlery, paper, and leather, and has some trade in grain, wine, timber, etc. Pop. (1891) 23,223.

ÉPINAY, *ā-pe-nā'*, LOUISE FLORENCE PÉTRONILLE DE LA LIVE D': French writer: 1725–83. At the age of 19, she married her cousin, M. d'Epinay, but the union was not happy. While her husband was abandoning himself to dissolute courses, she sought the intercourse of philosophers and men of genius. In 1745 she formed a close intimacy with Rousseau, and presented him with a small house (the now famous Hermitage) on one of her husband's estates in the woods of Montmorency. An unfortunate jealousy, however, which Rousseau conceived for Grimm, another friend of Madame d'E., was followed by an open rupture with his benefactress, and in his *Confessions* he scrupled not to malign her by way of vengeance. She spent the remaining 25 years of her life in comparative solitude, seeing only a small and select circle of philosophers and littérateurs. When Grimm was obliged to leave Paris, she continued, under the direction of Diderot, his literary correspondence with northern sovereigns. From the pen of Madame d'E. we have *Conversations d'Emilie* (Paris 1774), a work on education pronounced by the French Acad. to be the most useful published for a number of years; *Mémoires et Correspondance de Madame d'Epinay, renfermant un Grand Nombre de Lettres inédites de Grimm, de Diderot, et de J. J. Rousseau, etc.* (Paris 1818); *Les Confessions du Comte de ****; etc.

EPINEPHELE, n. *ēp-ē-nēf'ē-lē* [Gr. *epinephelos*, clouded; *epi*, upon; *nephelē*, a cloud]: in entom., genus of butterflies, family *Satyridae*. *Epinephele Janira* is the Meadow Brown. It is smoky-brown with a white-pupilled black spot on the upper side of the forewings; Europe. N. Amer. has a number of nearly related species, of the genera *Satyrus*, *Debis*, *Neonympha*, and *Apatura*, mostly meadow species, some woodland. The caterpillar of *Janira* is said to feed on grasses in the autumn and spring; the perfect insect is seen during hay harvest.

EPINGLETTE, n. *ēp-ēng-glēt'* [F.]: in ord., an iron needle for piercing the cartridge of a piece of ordnance before priming.

EPINIKIAN, a. *ēp-ē-nīk'ē-an* [Gr. *epinikios*]: pertaining to victory; triumphant.

EPIORNIS, n. *ē-pi-ōr'nīs* [see ÆPIORNIS]: a gigantic extinct bird of Madagascar.

EPIOTIC, a. *ēp-ē-ōt'īk* [Gr. *epi*, upon; *ōtos*, the ear]: in anat., name given by Prof. Huxley to the upper bone of the auditory capsule, part of the pars petrosa in man. It is the ossific centre corresponding to the lower part of the mastoid bone. It surrounds the posterior semi-circular canal, and extends into the mastoid portion.

EPIPACTIS, n. *ēp-ē-pāk'tīs*: a genus of orchids.

EPIPEDOMETRY—EPIPHANY.

EPIPEDOMETRY, n. *ěp-i-pě-dōm'ě-tri* [Gr. *epipedos*, on the ground, on the ground floor, level, flat; *epi*, upon; *pedon*, the ground; *metron*, a measure]: in geom., the measurement of figures standing on the same base.

EPIPERIPH'ERAL: see ENTOPERIPHERAL.

EPIPETALOUS, a. *ěp'i-pět'ă-lūs* [Gr. *epi*, and *petalon*, a petal]: inserted upon the petals.

EPIPH'ANITE: see EUKAMPTITE.

EPIPHANIUS, *ěp-i-fā'nī-ūs*, SAINT: Christian bishop, and writer of the 4th c.; b. of Jewish parents in Palestine; d. 403. He was baptized in his 16th year, and was educated among the Egyptian monks, who inspired him with an aversion to all liberal science. He rose gradually to the rank of Bp. of Constantia (formerly Salamis) in Cyprus, and continued in that office from 367 till his death. His polemical zeal was conspicuously manifested against Origen. In his writings he had proclaimed him a heretic; and in 394 he went to Palestine, the focus of Origen's adherents, and called upon John, Bp. of Jerusalem, and the two monks, Rufinus and Jerome, to condemn him. A more legitimate object of his violent opposition was the increasing worship of images. Jerome relates how he indignantly tore down an image in the precincts of a church in Palestine, as being contrary to the divine law. Among his writings, collected by Petavius (2 vols. Paris 1622), the most important is his *Panarion*, or catalogue of all heresies (80 in number), a work which strikingly shows his unfitness for a historian. His credulity and want of honesty are excessive.

EPIPHANY, n. *ě-přfă-ni* [Gr. *epiphanei'ă*, appearance—from *epi*, upon; *phainō*, I bring to light, I appear: F. *épiphanie*, epiphany—from L. *epiphāniā*, manifestation]: among the heathen Greeks, a festival in commemoration of the appearance of a god in any particular place. The word subsequently passed into the usage of the Christian Church to denote in general the manifestation of Christ to the world, and was applied in the Eastern Church to a festival opening the Christian year and celebrating the manifestation or appearance of Christ upon the earth, with special reference first to His baptism, at which time He was proclaimed from the heavens as the glorious and eternal Son of God, and so was manifested on earth. His birth was viewed as merely a preliminary to his baptism, and both were celebrated together, Jan. 6.—the two festivals of Christmas and E. not being separated till toward the end of the 4th c. Indeed, in the Eastern Church, E. became a favorite term for Christian baptism. The festival, passing to the Western Church (recorded first in 360), was changed as to its basis, and referred to the manifestation of Christ to the Gentiles on the day when he was seen and worshipped by the three wise men who came from the East: see MAGI. It also ceased to be used to denote baptism. This occasion is still commemorated in large portions of the church on Jan. 6, the 12th day after Christmas; hence the E. is called

EPIPHEGUS—EPIPHYTE.

also Twelfth Day. The E. is observed as a ‘scarlet day’ at Oxford and Cambridge universities.

EPIPHEGUS, *a.* *ěp'i-fē'gūs* [Gr. *epi*, upon; *phēgos*, a kind of oak, not the Latin *fagus* (beech)]: in *bot.*, genus of *Orobanchaceæ*, Broomrapes. *Epiphegus virginiana*, a N. American parasite on the roots of the beech, is believed to have been one ingredient in Martin’s cancer powder, white oxide of arsenic being another.

EPIPHLŒUM, *n.* *ěp'i-flē'ūm* [Gr. *epi*, upon, on the outside; *phloios*, bark]: an external layer of bark. **EPIPHLŒODAL**, *a.* *ěp'i-flē'ō-dāl*, existing superficially in the epidermis of bark.

EPIPHONEM, *n.* *ě-piſ'o-nēm*, or **EPIPHONE'MA**, *n.* *-nē'ma* [Gr. *epiphōnēmu*, a thing uttered; *epiphōneō*, I utter; *phōneō*, I speak or utter]: in *rhet.*, exclamatory sentence or striking reflection which sums up or concludes a discourse.

EPIPHORA, *n.* *ě-piſ'ō-rā* [Gr. *epiphōrā*, a bringing to or upon—from *epi*, upon; *phērō*, I bring]: watery eye, a disease in which the tears flow over the cheek from an obstruction in the canal which should carry them off; violent determination of the fluids to any part of the body, produced in general by inflammation.

EPIPHRAGM, *n.* *ěp'i-frām* [Gr. *epi*, upon; *phragma*, a division]: in *bot.*, the membrane closing the orifice of the thecæ in the urn mosses.

EPIPHYLLOUS, *a.* *ěp'i-fil'lūs* [Gr. *epi*, *phullon*, a leaf]: inserted on a leaf, or growing upon it. **EPIPHYLLUM**, *n.* *ěp'i-fil'lūm*, one of the cactus family; a genus of plants whose stems consist of fleshy lobes or leaf-like expansions; splendid flowering-plants, so called in allusion to the flowers growing on the flat branches, which appear like leaves. **EPIPHYLLOSPER'MOUS**, *a.* [Gr. *epi*, *phullon*, *sperma*, a seed]: having the seeds on the back of the frond or leaf. Plants of this character are now called dorsiferous ferns.

EPIPHYSIS, *n.* *ě-piſ'i-sis* [Gr. *epi*, *phūō*, I grow]: that which grows on something else; a part of a bone formed at first separately from the shaft or body, and afterward united to it.

EPIPHYTE, *n.* *ěp'i-fit* [Gr. *phūtōn*, a plant—from *epi*, upon; *phūō*, I grow]: plant not rooted in the ground, but growing on another, but which does not, like a parasite, derive its nourishment from the other; plant attached to another plant, and growing suspended in air; popularly, but less correctly, called AIR-PLANT. They are found attached to trees, from the decaying portions of the bark of which, or of mosses and lichens which grow upon it, they derive their nutriment, probably, also drawing it from the air to a larger extent than other plants do. Mosses and lichens themselves, growing upon trees, may be called epiphytes, but the term is generally used of phanerogamous plants. Epiphytes are not connected with the trees on which they grow in the peculiar manner of the mistletoe,

EPIPLEROSIS—EPIPOLISM.

Balanophora, and other true parasites—not sending roots like them into the wood to suck the juice of the tree. It is chiefly in warm and moist climates that phanerogamous epiphytes are found. Most of them prefer shady situations. Within the tropics, they often form an interesting and remarkable feature of the vegetation. Some of the *Bromeliaceæ* (as *Tillandsia*), *Cactaceæ*, *Araceæ*, *Gesneraceæ*, and other nat. orders are epiphytes; but the order to which they belong more than to any other is *Orchidaceæ*. Many of the epiphytic orchids, as well as other epiphytes, are remarkable for beauty; and the attention which has recently been given to their cultivation in hot-houses has been rewarded by perfect success. See ORCHIDS. Plants which usually occur as epiphytes are sometimes found growing on rocks also. Although seldom found except in moist climates, epiphytes are generally capable of enduring considerable drought, parting slowly with the moisture which they have once imbibed. EP'IPHYTES, n. plu. -*fitz*, or EP'IPHYTA, n. plu. ē-*pif-i-tă*. EP'IPHYT'IC, a. -*fit'ik*, or EP'IPHYT'ICAL, a. -*i-käl*, and EP'IPHYTAL, a. -*fi'täl*, pertaining to; growing upon another plant.

EPIPLEROSIS, n. ēp-i-plē-rō'sis [Gr. *epiplērosis*; *epi*, plērosis, repletion]: in med., over-repletion; excessive fulness or distention, as of the arteries with blood.

EPIPLEXIS, n. ēp-i-plēks'is [Gr. *epiplexis*—from *epi*-*plēssō*, I chastise, I rebuke; *epi*, upon; *plēssō*, I strike]: in rhet., figure by which a person seeks to convince and move by gentle upbraiding.

EPIPLOCE, n. ē-pip'lō-sě, or EPIP'LOCY, n. -*sī* [Gr. *epiplokē*, a plaiting together—from *epiplekō*, I plait together; *epi*, upon; *plekō*, I plait, I fold]: in rhet., figure by which one aggravation, or striking circumstance, is added in due gradation to another; as, He not only spared his enemies, but continued them in employment; not only continued them in employment, but advanced them.

EPIPLOON, n. ē-pip'lō-ōn [Gr. *epiplōon*, the caul—from *epi*, upon; *plein*, to sail, to swim]: the caul—a portion of the peritoneum or lining membrane of the abdomen, which covers in front, and as it were floats on, the intestines. EPIPLOIC, a. ēp'i-plo'ik, pertaining to the epiploon or caul.

EPIPODIA, n. plu. ēp'i-pō'di-ā [Gr. *epi*, upon; *poda*, a foot]: the muscular lobes developed from the lateral and upper surfaces of the foot of some mollusks. EPIPODITE, n. ē-pip'ō-dit, a process developed upon the basal joint of some of the limbs of certain crustacea. EPIPODIUM, n. ēp'i-pō'di-ūm, a disk formed of several knobs or glands.

EPIPOGIUM, n. ēp'i-pō'jī-ūm [Gr. *epi*, upon; *pōgōn*, the beard, from the lip being uppermost]: in bot., genus of orchids.

EPIPOLISM, n. ē-pip'o-lizm [Gr. *epipolē*, a surface]: same as FLUORESCENCE: see FLUOR. EPIP'OLIZE, v. -*liz*, to affect or modify by the phenomena of epipolism; to change into an epipolic condition. EPIPOLIZED LIGHT, n. in optics, light acted on by epipolic dispersion.

EPIPTEROUS—EPISCENIUM.

EPIPTEROUS, a. *ē-pip'ter-ūs* [Gr. *epi*, upon; *pteron*, a feather, a wing]: in *bot.*, having a wing at the top.

EPIRRHEOLOGY, n. *ē-pir'i-ōl'ō-jī* [Gr. *epirrhōē*, a flowing on; *logos*, discourse]: that branch of natural science which treats of the effects of external agents on living plants.

EPIRUS, *ē-pī'rūs*: ancient name of a part of Greece, bounded e. by the chain of Pindus, s. by the Ambracian Gulf, w. by the Ionian Sea, and n. by Illyria and Macedonia. It formed the s. part of modern Albania, or the pasheaic of Janina, a wild and mountainous region, haunt of robbers and semi-civilized tribes in all ages. The chief town was Dodona (q.v.); the chief rivers, the Acheron, Cocytus, Arachthus, and Charadrus. Anciently, it was celebrated for its cattle and its breed of Molossian dogs. Its earliest inhabitants were probably Pelasgians. In the historic period, Theopompos speaks of 14 tribes, most of whom were believed by the Greeks themselves to be not of Hellenic origin. The principal were the Chaones, Thesproti, and Molossi, the last of whom finally obtained the entire sovereignty of the country. Of the Molossian kings of E. the most distinguished was Pyrrhus, who long waged successful war against the Romans. But after this race of kings became extinct (B.C. 230-229) by the death of Ptolemy, grandson of Pyrrhus, a republican constitution was adopted, whereupon parties sprang up among them, and the neighboring Macedonians got the upper hand. On the conquest of Macedonia by the Romans (168 B.C.), the Epirots were accused of having assisted Perseus, the Macedonian king, and the most revengeful measures were put in force against them. Æmilius Paulus, the Roman general, plundered and razed to the ground the 70 towns of E., and sold into slavery 150,000 of the inhabitants. From this period, E. shared the vicissitudes of the Roman and Byzantine empires, until 1204, when one of the Comneni made himself independent. His dynasty ruled the country until 1466, when it was finally conquered by the Turks (see SCANDERBEG). E. peopled largely since the 14th c. by Albanians (see ALBANIA), formed latterly a part of the Turkish vilayet of Janina. The Berlin Congress, 1878, recommended that the s. part of E. should be ceded to Greece; and through the mediation of the Six Western Powers, the district e. of the river Arta was ceded to Greece 1881.

EPISCENIUM, n. *ēp-i-sēn'i-ūm* [Gr. *episkēnion*—from *epi*, upon, over; *skēnē*, the scenes]: in *Gr. arch.*, a division of the scene of a Greek theatre; it sometimes consisted of three divisions made by ranges of columns one above the other; the lower was termed *scena*, and the others *episcenia*.

EPISCOPACY.

EPISCOPACY, n. *ē-piš'kō-pā-sī* [Gr. *episkopēō*, I oversee; mid. L. *episcōpūs*, an overseer—from Gr. *epi*, upon; *skōpēō*, I see]: church government by bishops; the order of bishops in the English and other churches. EPISCOPAL, a. -*pāl* [F.—L.]: pertaining to Episcopacy. EPISCOPALIAN, n. -*pā-lī-ān*, an adherent or member of the Chh. of Eng., or of a church governed by bishops. ADJ. pertaining to. EPISCOPALLY, ad. -*lī*. EPISCOPALIANISM, n. -*lī-ān-īzm*, the system of episcopal church government. EPISCOPATE, n. -*pāt*, the order of bishops; office and dignity of a bishop.

EPISCOPACY form of church government in which one order of the clergy is superior to others; viz. bishops (prelates) to ordinary pastors or presbyters (priests). It is called sometimes *diocesan episcopacy*, in distinction from that episcopacy which Congregationalists and Presbyterians also assert—the oversight of a local church or congregation by its pastor: see BISHOP. It is not essential to E. that there should be *archbishops*, exalted in rank or authority over other bishops. E. has actually subsisted under very various modifications; the power of bishops being more or less in extent, more or less controlled by synods of presbyters, or even—in the Prot. Episc. Church in the U. S.—by a diocesan convention of presbyters and lay delegates. The power of the bishop also is variously affected by the relations between church and state; and great differences in this respect exist between the Church of England, the Church of Sweden, and the Church of Denmark, all Episcopalian, and all connected with the state as *established* churches. See ANGLO-CATHOLIC CHURCH: CHURCH OF ENGLAND: EPISCOPAL CHURCH, PROTESTANT: ROMAN CATHOLIC CHURCH: GREEK CHURCH: ETC.

There is now, among biblical scholars, general agreement that the Greek words for ‘bishop’ and ‘presbyter’ in the New Testament are applied to the same church officer: the former describing his work as a superintendent; the latter, a title of reverence. Thus, the apostle Paul calls the ‘presbyters’ of the Ephesian Church ‘bishops of the flock;’ and the apostle Peter, styling himself a ‘presbyter,’ addresses his brother ‘presbyters’ as holding the office of ‘bishop.’ In each single church also, so far as appears, there was, as originally organized, a plurality of ‘bishops.’ Presbyterian and Congregational churches call their pastors or ministers ‘elders’ (that is presbyters) and ‘bishops,’ and regard them as constituting the one order in the ministry. Refusing a diocesan, they hold to a parochial episcopate; and are not known in popular language as holding to episcopacy.

The Roman Catholic Church teaches that its hierarchy of bishops, priests, and deacons, has been instituted by divine ordinance; that the bishops are the immediate successors of the apostles; that ordination confers a special grace; and that the pope or bishop of Rome, as the immediate successor of Peter and the vicar of Christ, is the head of the episcopate throughout the world, and has authority over the universal church.—The Greek or Eastern Church (like the Roman) teaches the divine origin of episcopacy, apostolic

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succession, and the conveying of grace in ordination by the imposition of hands: but calls the pope of Rome a usurper; and does not acknowledge the supreme authority of any earthly head over the bishops and the church.—The Jansenists of Holland, and the Old Catholics maintain the divine authority of episcopacy, but do not acknowledge allegiance to the pope. Their own episcopal orders were obtained through Rom Cath. hands.—In the Church of England and the Prot. Episc. Church of the U. S. two grades of opinion are held: 1. The Anglo-Catholic or ‘high church’ view declares that episcopacy is necessary to the *existence* of the church; that grace is imparted in ordination through the imposition of hands; and that the apostolic succession has been maintained. 2. The ‘low,’ or ‘broad church’ view teaches that episcopacy is necessary for the *well-being* of the church, but not to its existence; and that the episcopate was gradually and wisely formed out of the presbytery. This view was prevalent among the Protestants at the Reformation. Few then among English clergymen maintained the divine right of episcopacy. The most eminent of them acknowledged the validity of presbyterian orders; some of them had themselves been thus ordained. Many in the English Church hold this opinion still. Dean Stanley says, ‘According to the strict rule of the church, derived from these early times, there are only two orders —presbyters and deacons.’ Bishop Lightfoot says, ‘At the close of the apostolic age, the two lower orders of the three-fold ministry were firmly and widely established; but traces of the episcopate, properly so called, are few and indistinct.’ . . . ‘The episcopate was formed out of the presbyterial order by elevation; and the title, which originally was common to all, came at length to be appropriated to the chief of them.’—The Moravian Church has episcopal ordination, derived, 400 years ago, from a regularly ordained Waldensian bishop; but it acknowledges the ordination of other Christian churches, and freely receives ministers coming from them.—The Lutheran Church of Germany has only one order of ministers, with an officer called a superintendent. In Sweden the Lutherans have bishops (the validity of whose ordination is not clearly established), but maintain the equality of the ministry. In Denmark the bishops do not claim an unbroken apostolic succession.—The Reformed Episcopal Church ‘adheres to episcopacy, not as of divine right, but as a very ancient and desirable form of church polity.’ It derives its orders from Bishop Cummins, who had been consecrated in the Prot. Episc. Church.—The episcopacy of the Methodist Church in America avowedly rests on a presbyterial foundation; the first bishop having been ordained by John Wesley, who was a presbyter in the Church of England, and regarded the office which he thus originated as one of expediency and of superintendence. The Methodist bishops thus continue to be presbyters, elected by the representatives of the whole church, and accountable to them. They have no individual dioceses, but form ‘an itinerant general superintendency.’

EPISCOPAL CHURCH.

EPISCOPAL CHURCH, PROTESTANT: daughter or offshoot of the Church of England, agreeing with her in doctrine, discipline, and worship. Known during the colonial period as 'The Church of England in America,' it was organized after the attainment of independence as 'The Protestant Episcopal Church in the United States of America.'

Sir Humphrey Gilbert, in 1578, received authority to settle in any unoccupied regions of the new world, and was instructed to govern any colonies which he might form by laws agreeable to the policy of England and to the faith of the established church. In that year the communion was celebrated on the shores of Frobisher's Straits. White, governor of Raleigh's second colony, baptized his granddaughter Virginia Dare and an Indian on shipboard off Roanoke Island, N. C. Sir Thomas Hariat used the Prayer-Book among the Indians in 1585. Captain R. Weymouth sailed up the Penobscot 1605, and erected a cross near where Belfast, Me., now stands. The Rev. R. Seymour and others built a church and a fort at the mouth of the Kennebec 1607, Aug., but abandoned the place the following year. Meantime a permanent settlement was effected at Jamestown, Va., where the Rev. Robert Hunt held the first services, 1607, May, under an awning; a church was soon built, and common prayer recited every morning and evening, with two sermons on Sunday, and the communion every three months. Hunt was succeeded as chaplain by Buck and Whitaker: the latter baptized Pocahontas, and was called the Apostle of Virginia. In Md. also this church had an advantage, except during the rule of the Independents, who repealed the colonial laws of toleration, and proscribed 'popery and prelacy.'

In the northern colonies the population was hostile or indifferent to the English Church, and the English clergy were infrequent visitors, though Gov. Gorges took one with him to Massachusetts Bay 1623, and another settled at Shawmut, whence he removed to R. I. 1630, on or before the building of Boston. Two of the patentees of Salem were banished thence 1629 for using the Prayer-Book. Persons who petitioned for its use at Boston, 1646 and 1664, were treated as seditious, but in 1679 King's Chapel was erected. In New York the first services, so far as known, were held 1678, and Trinity church was built and endowed 1696. In Penn. nothing appears to have been done till 1695.

The church thrrove as it might without ordination or confirmation, for it was never favored with the presence of a bishop, and its ministers necessarily came from England, or went thither to be ordained. The bp. of London, who was supposed to be in charge of its interests, sent to Va. as his commissary in 1685 Dr. Blair, who held the office till 1738, and sent in 1700 Dr. Bray in the same capacity to Md. The latter procured the establishment of the important Societies for Promoting Christian Knowledge and for the Propagation of the Gospel in Foreign Parts; the latter provided some clerical stipends, and sent missionaries into the

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colonies where the church was not established. Before this work began, S. C. and N. C. had no Episcopal ministers; Va. had 40 parishes and Md. 26, but in each case but half as many clergy. In Penn. there were but 250 communicants and 700 attendants. In N. Y. the numbers were 450 and 1,200, and throughout New England 185 and 900. In Conn. a movement toward this church began in Yale College, when Dr. Cutler, the rector, and two tutors resigned their posts, and went to England for ordination 1723. One of them, Brown, died of smallpox abroad, and his fate deterred others from following his example. Cutler labored long at Boston, and Johnson at Stratford, Conn., enduring much persecution. Efforts were repeatedly made to procure a bp. for America, but in vain. Bequests were made to endow a see, and a house provided at Burlington, N. J., but the story, long believed, that Talbot, minister there, had received consecration from the nonjurors, appears to be disproved.

The Episcopal Church in America was all this time at a disadvantage as compared with the other religious bodies. They were self-propagating, while the sources of her organic life were across the sea. ‘The fountain of all our misery,’ said one, ‘is the want of a bishop.’ But bishops, as officers and too frequently pliant tools of a sometimes oppressive government, were coldly regarded by many who liked the service of the English Church. In Va. and Md., where the church was nominally prevalent, her members showed no such zeal for their faith and forms as did the New England Puritans. Lacking supervision, some of her ministers were of unworthy life, and her parishes had little relation to each other. There was practically no government, no bond of union, no coherence, and little spirit of union or zeal.

At the outbreak of hostilities most of the clergy and many of the laity were loyal to the crown, and the connection of the church with England made her very name a byword of reproach to the generality of patriots. In 1775 there were some eighty ministers n. of Md., mostly supported by the S. P. G. in London; this number was soon greatly reduced. After the war only one of ten clergy remained in Penn., and a single parish. In Va., of 164 churches but 69 remained, and 28 of 91 ministers; funds could not be provided to send Dr. Griffith to England, to be consecrated with Drs. White and Provoost.

From this depressed condition the church was rescued largely through the energy and prudence of Dr. White of Philadelphia. He published, 1782, Aug., a pamphlet, *The Case of the Episcopal Churches Considered*, in which he proposed a lay share in council and government, the equality of all parishes, and the election of ‘a superior order of clergy,’ who should assume, as far as might be, the functions of bishops, till these could be secured. The last suggestion was soon made needless; the others were incorporated in the constitution of the church. In 1783 he opened a correspondence with the few remaining clergy and with influential laymen in the several states, looking

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to a revival and organization of the church. After meetings at Philadelphia, New Brunswick, and New York, the first General Convention assembled at Philadelphia, 1785, Sept. In this New England and N. C. were not represented. An address to the English bishops and a 'Proposed Book' were prepared, but neither met with favor.

Meanwhile Dr. Seabury, elected in Conn., had repaired to England for consecration. The bishops there were not authorized to dispense with the oath of allegiance, which could no longer be taken by Americans: at length, 1784, Nov. 14, he was consecrated in Aberdeen by the Scottish bishops, Kilgour, Petre, and Skinner, and returning home, 1785, June, began to exercise his office. Difficulties in England being soon after removed, Drs. White and Provoost, elected in Penn. and N. Y., were consecrated at Lambeth chapel, 1787, Feb. 4, by the two archbishops and two others, the bp. of Peterboro and the bp. of Bath and Wells.

The three bishops met as an upper house in the General Convention of 1789, at which the church was fully organized on a principle of the equality of dioceses, each of which received a representation of four clerical and four lay delegates. The constitution was mainly the work of Bp. White; he and Bp. Seabury bore the chief share in the revision of the Prayer-Book, which differs from that of England (beyond the changes necessary in passing from a monarchy to a republic) in the happy omission of the Athanasian Creed, and the substitution, in large measure, of the Scottish Communion Office. Diocesan Conventions were left to manage local affairs, while the General Convention became the supreme legislative body.

In 1790 Dr. Madison was consecrated in England as bp. of Va. All later consecrations were conducted at home; but progress for some years was slow. In 1808 and 1811 but two bishops were in attendance on the General Convention. In the latter year Bps. Hobart and Griswold were consecrated, and a vexed question about land titles called forth the formal declaration that the P. E. Church was no new body, but the one formerly known as the Church of England in America. Throughout these early years Bp. White was the presiding genius. His gentle firmness, his unfailing tact, his wise toleration, his beloved and saintly character, made him to his church what Washington was to the country. He lived to consecrate 26 bps., and see his diocese grow from nearly nothing to 86 clergy and 21 congregations. His *Memoirs of the Protestant Episcopal Church* (1820; enlarged 1836) is unfaithful to history only in belittling his own services.

A few facts and figures will illustrate the varying rates of progress. N. C., which had in 1770 eighteen clergy, could muster but 11 in 1830; it has now two large dioceses. Va., which was much weaker in 1814 than in colonial days, was revived by Bp. R. C. Moore. S. C. has arisen from nine parishes in 1786 to nearly 100. Under Bp. Doane in N. J. (1832-58) the number of clergy increased from 14 to 94, and of communicants from 800 to 4,500, the

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latter since quadrupled and assigned to two dioceses. The first bishop w. of the Alleghanies was Dr. Chase, consecrated for Ohio, 1819. The first missionary bishop of the northwest, Dr. Kemper, was appointed 1835. Ill. now comprises three dioeeses, Mieh. three and Wis. two. Penn. has three; N. Y. five, all of good size and strength; and some of them, especially that comprising the city of New York, are marvellous for their growth in the last quarter-century—a growth now increasing even its previous rapid rate by constant accessions from other denominations. The general increase of this denomination in this century has been nearly three times that of the population. In the great cities many of the parishes are superbly and elaborately equipped with every external appliance for parochial work.

About half a century ago party spirit was rife in the Episcopal Church. Dissensions were frequent concerning ritual observances and the higher or lower theories of the church. Bishop Benjamin T. Onderdonk of N. Y., who, on charges of misconduct, was suspended from his office in 1844, was even deemed by many to have been sacrificed for opinions then considered extreme. Bishop Doane of N. J., obnoxious to some for similar reasons, was subjected to trial (1849-53), but honorably acquitted. The persecuting spirit has long since utterly ceased, and there is now probably a wider range of opinions, doctrinal and ecclesiastical, among clergy and laity, and a more unquestioning tolerance thereof, than in any other Trinitarian body. Far more stress is now laid than formerly on church architecture and decoration, music, the beautifying and popularizing of the services, and on parochial work among the destitute classes, and proportionately less stress on dogmatic distinctions. Views and practices called 'High Church' prevail in most dioceses; but party lines are not sharply drawn, and few would deny the liberty of thinking, whether to the advanced ritualist, the antique evangelical, or the modern liberal. This freedom and lack of insistence on theories and symbols, deplored by some as a source of weakness, is rejoiced in by more as a sign of truth and strength. 'The roomiest church in America,' as it has been called, allowing for varieties of temperament, emphasizing the practical side of religion, having for its root-idea education rather than conversion, and not exacting a prescribed routine of spiritual experience, may, of course, be sought by some from mixed or unworthy motives; but it aims at inclusion, considering itself not so much a communion of saints as a nursery for heaven.

The bishops in this church, though endued with high powers, have become notable for that paternal, even fraternal, spirit which gives to any exercise of power its highest warrant. See **BISHOP**.

In every diocese the bishop and his clergy in person, and the laity by their delegates, meet often as once a year in the Diocesan Convention, or Council. This body exercises legislative authority in its diocese, enacting canons of discipline, admitting new parishes, electing a

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bishop in case of vacancy, voting on changes in the Prayer Book if proposed by the General Convention, etc.

The supreme legislative authority for the whole church is exercised by the General Convention as representative of all the federated dioceses. It meets once in three years, and consists in two co-ordinate bodies, the House of Bishops, and the House of Clerical and Lay Deputies. For its decisions a concurrent vote in both these houses is requisite; and, on demand, the vote must be 'by dioceses and orders'; i.e. a majority, to be conclusive, must be a majority of all the dioceses as represented in convention by their *clergy*, concurring with a majority of all the dioceses as represented in convention by their *laity*.

Of more than 150 bishops, past and present, two have left this church; L. S. Ives of N. C., who went to the Church of Rome 1853, and G. D. Cummins of Ky., who started the Reformed Episcopal Church (q.v.) 1873. One bishop has been deposed on moral grounds. Five have resigned their office—all missionary bishops, and four of them in foreign fields; the fifth was afterward elected to a diocese.

During the civil war a temporary schism occurred, as in other denominations seated in both the north and the south. The southern dioceses organized themselves as the 'Church in the Confederate States,' and were not represented in the General Convention of 1862; but in that of 1865 their bishops and delegates were welcomed back, and a reunion was at once effected.

This church increasingly recognizes the need of cathedrals, not only to supply models of dignified worship, but also to stand as visible centres of administration in their respective dioceses. From the cathedral, with the bishop and his organized staff, may be sent forth in orderly lines the incentive and the guidance for all Christian work, educational and charitable. The diocese of N. Y. has now under construction, on a commanding eminence in the upper part of New York city the Cathedral of St. John the Divine, which, in grandeur, in beauty, and as a model of adaptedness to the manifold uses of a central diocesan establishment, is expected to be the noblest ecclesiastical edifice in the country.

Official reports of 1903 show the following for 1902: Clergy, 4,971; candidates for orders, 448; postulants, 288; lay readers, 1,935; parishes and missions, 6,647; baptisms, 59,016 (infant 46,031, adult 10,704); confirmed, 46,171; marriages, 21,125; burials, 34,761; communicants, 758,052, an inc. over preceding year of 14,193, or 2 per cent., and an inc. of 138,614 in seven years: S. S. teachers, 46,318; scholars, 416,573. Church is the strongest in N. Y. State. Total contributions, \$15,146,470, making an average per member of \$19.98; highest average in any state, N. Y. \$33.83; lowest, S. D., \$5.98.

This church, through General Convention or otherwise, supports a number of educational institutions. The theological schools are: the General Theol. Seminary, New York city, established 1817; Virginia Theol. Sem., near

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Alexandria, 1823; Berxley Hall, Gambier, O., 1825; Nashotah House, Nashotah, Wis., 1841; Berkeley Divinity School, Middletown, Conn., 1854; Seabury Divinity School, Faribault, Minn., 1860; Divinity School, Philadelphia, 1862; Episc. Theol. School., Cambridge, Mass., 1867; Theol. Dept. Univ. of the South, Sewanee, Tenn., 1868; Western Theol. Sem., Chicago, Ill., 1885; Lee Hall, Davenport, Ia. Diocesan schools are at San Mateo, Cal.; Denver, Colo.; Topeka, Kan.; Geneva, N. Y. (De-Lancey Divinity School); Syracuse, N. Y. (St. Andrew's Divinity School); Shanghai, China; and Tokio, Japan. Prominent among church colleges are (1895): the Univ. of the South, Sewanee, Tenn., established 1868, with 29 instructors and 296 students; Kenyon Coll., Gambier, O., 1834, with 19 instructors and 180 students; Griswold Coll., Davenport, Ia., 1859, with 26 instructors and 180 students; Hobart Coll., Geneva, N. Y., 1825, with 17 instructors and 81 students; Trinity Coll., Hartford, Conn., 1823, with 19 instructors and 130 students; and Racine Coll., Racine, Wis., 1853, with 6 instructors and 40 pupils.

A list of other institutions (1902) will give some idea of the varied activities of this church. The Domestic and Foreign Missionary Soc. has for its members all baptized persons in the church, and is governed by a council consisting of all the bishops and numerous clergy and laymen. The Church Building Fund Commission organized 1880; the Church Society for Promoting Christianity among the Jews; the Commission for Church Work among Colored People; and the Church University Board of Regents; incorporated 1890. These, and a Fund for the Relief of Widows and Orphans of Deceased Clergymen, and of Aged, Infirm, and Disabled Clergyman, are controlled by General Convention. The American Church Missionary Soc., incorporated 1861, and the Evangelical Education Soc., 1861-69, represent the 'Low Church' party. The Soc. for the Increase of the Ministry, 1859, has its headquarters at Hartford, Conn. The N. Y. Bible and Common Prayer-Book Soc. was founded 1809; the Prot. Episc. Soc. for Promotion of Evangelical Knowledge, incorporated 1848, has its publishing house in New York. The Free and Open Church Association aims to substitute free seats for rented pews. Missions to Deaf Mutes are in New York and at Gambier, O. The Clergymen's Mutual Insurance League was incorporated 1869, the Clergymen's Retiring Fund Soc. 1874, the Soc. of St. Johnland 1870. The Church Congress (q.v.) meets annually. Other institutions of recent date are the Church Temperance Soc., the Western Church Building Soc., the Church Unity Soc., the Brotherhood of St. Andrew, (with 1,167 chapters and 12,500 members), the White Cross Soc. (1886), the Parochial Mission Soc., the Confraternity of the Blessed Sacrament, the Soc. for the Home Study of the Holy Scripture and Church History, the Guilds of the Holy Cross, of the Iron Cross, of S. Barnabas for Nurses (with branches in 25 cities and 1,700 members), and of All Souls (1873), the Church Assoc. for the Advancement of

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the Interests of Labor, Men's Help Soc., the Christian Social Union in the U. S., Knights of Temperance, and Young Crusaders, Woman's Auxillary to the Church Temperance Soc., Church Students' Missionary Assoc. (1888), the American Church League, the Church German Soc. of (1879), Soc. of King Charles the Martyr (1894), the Order of the Daughters of the King (1885), the Order of the Sisters of Bethany (1891), the Community of St. Benedict (1894), the Church Periodical Club, American Church Sunday-school Institute, and the Church Army (1896). Some of these have acquired much influence. There are also 22 Sisterhoods, which have charge of schools, hospitals, orphanages, etc., in all parts of the country; and there are 4 religious orders for men and 23 church clubs. It is evident that this church is not content with offering historic claims and an attractive service, but is endeavoring to do her share of work among all classes of the community.

A peculiarity in the distribution of the membership of the Protestant Episcopal Church in the U. S., is the centring of her strength in the large cities, 38 per cent. of the entire number being massed in 44 of the principal cities. According to states, this peculiarity is shown as follows: In Cal. nearly one-third of the total membership in the state is in San Francisco; in Colo. about one-half in Denver; in Conn. about one-third in the cities of New Haven, Hartford, Bridgeport, and Waterbury; in Del. about one-half in Wilmington; in Ga. more than one-half in the cities of Savannah, Atlanta, and Augusta; in Ala. nearly one-third in Mobile; in Ill. one-half in Chicago; in Ind. one-fifth in Indianapolis; in Ky. one-half in Louisville; in La. three-fifths in New Orleans; in Me. nearly one-third in Portland; in Md. more than two-fifths in Baltimore; in Mass. nearly one-fourth in Boston; in Mich. about one-third in Detroit; in Minn. nearly one-half in the cities of Minneapolis and St. Paul; in Mo. more than four-fifths in St. Louis; in Neb. two-fifths in Omaha; in N. J. about one-third in the cities of Jersey City, Newark, Orange, and Camden; in N. Y. considerably more than one-half in the cities of New York, Brooklyn, Buffalo, Rochester, Albany, Troy, Utica, and Syracuse; in O. more than two-fifths in the cities of Cleveland, Cincinnati, and Toledo; in Penn. three-fifths in the cities of Philadelphia and Pittsburg; in S. C. two-fifths in Charleston; in Tenn. one-third in Memphis and Nashville; in Va. one-fourth in the cities of Richmond and Norfolk; in Wis. one-fifth in Milwaukee.

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EPISCOPAL CHURCH, REFORMED: organized by members of the Prot. Episc. Church, who give substantially the following statement of the events and circumstances which, as they believe, justify their course. 1. The Protestant Reformation in England had outwardly a political origin (in the act of the king, Henry VIII., renouncing allegiance to the pope, and proclaiming himself head of the English Church), by which the work was biased and cut short. During the brief life of the young king Edward VI., the regent, or protector, being in favor of the Reformation, great progress in it was made. Under Mary the supremacy of the pope was again acknowledged. When Elizabeth became queen, wishing to harmonize her divided subjects, and hoping for reconciliation with Rome, she strove to have the liturgy framed so as to satisfy both parties. Consequently it contained contradictory elements. At a later period, when she had found her hope futile, the articles of faith adopted were decidedly Protestant. Thus it came to pass that in the Church of England two parties found support in her ritual; the one Protestant; the other having an affinity with Rome. 2. After the American revolution, when the Church of England in the colonies became the Prot. Episc. Church in the United States, the Book of Common Prayer, having been adopted without material alterations, retained its conflicting elements. 3. The Tractarian movement, which began at Oxford, 1833, was a successful endeavor to revive the principles of antiquity and Catholicity contained in the Prayer Book, in opposition to its Protestant elements. It discarded Prot. principles and taught the doctrines of apostolic succession, priestly absolution, baptismal regeneration, the real presence, and the authority of the church. 4. These teachings produced a powerful effect in the United States also. A great increase of ritualism and of the drift toward Rome was soon manifested; the opposition between the 'High' and the 'Low Church' parties was intensified, and practical measures were adopted by each which widened the chasm. 5. Several subsequent public events fanned the flame of discontent; especially the censure of one clergyman for preaching in a Methodist church, and the suspension of another for omitting the word 'regenerate' in the baptismal office. 6. Remonstrances and petitions for relief, which were numerous and urgently presented to the General Convention, produced no effect. 7. During the sessions of the Evangelical Alliance in New York 1873, Oct., Bp. Cummins, of the diocese of Kentucky, having, by invitation, officiated at a union celebration of the Lord's Supper, in company with representatives of other denominations, was for this act of Christian fellowship bitterly censured, through the press, by members of the 'High Church' party. After this, convinced that he could no longer rightfully continue in a church whose theory and practice (as interpreted by the majority of its members) denied the brotherhood of believers in Christ, Bp. Cummins withdrew from the ministry of the Prot. Episc. Church. 8. This led to the or-

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ganization, 1873, Dec. 2, of the Reformed Episcopal Church, of which Bp. Cummins and the Rev. Dr. Charles E. Cheney were elected bishops. At the same time the following declaration of principles was adopted: 'I. The Reformed Episcopal Church, "holding the faith once delivered to the saints," declares its belief in the Holy Scriptures of the Old and New Testaments as the Word of God, and the sole rule of faith and practice; in the creed "commonly called the Apostles' creed;" in the divine institution of the sacraments of baptism and the Lord's Supper; and in the doctrines of grace substantially as they are set forth in the Thirty-nine Articles of Religion. II. This church recognizes and adheres to Episcopacy, not as of divine right, but as a very ancient and desirable form of church polity. III. This church, retaining a liturgy which shall not be imperative or repressive of freedom in prayer, accepts the Book of Common Prayer, as it was revised, proposed, and recommended for use by the General Convention of the Prot. Episc. Church, 1785; reserving full liberty to alter, abridge, enlarge, and amend the same as may seem most conducive to the edification of the people, "provided that the substance of the faith be kept entire." IV. This church condemns and rejects the following erroneous and strange doctrines as contrary to God's Word: 1. That the church of Christ exists only in one order or form of ecclesiastical polity. 2. That Christian ministers are "priests" in another sense than that in which all believers are "a royal priesthood." 3. That the Lord's table is an altar on which the oblation of the body and blood of Christ is offered anew to the Father. 4. That the presence of Christ in the Lord's Supper is a presence in the elements of bread and wine. 5. That regeneration is inseparably connected with baptism.' To this statement it may be added that in this church the bishops do not constitute a separate order, but are presbyters; in council they vote with and as their brother presbyters. In 1902 the official reports showed 100 ministers, 78 churches, and 9,282 members.

EPISCOPAL SYSTEM, in the Roman Catholic Church: theory which claims for the whole body of bishops the supreme power in the church. It was brought out strongly by the conflicting papal elections which, commencing 1378, established rival popes at Avignon and at Rome. The council of Pisa (1409) cited the rivals before them, and, on their refusal to appear, deposed them. The council of Constance (1414) finding three rival popes deposed them all. The council of Basel (1431) denied the right of the pope to dissolve it, and cited him to appear at its bar. In 1439 it declared him a heretic, and afterward deposed him. In later times the superiority of a general council over the pope continued to be maintained by the Gallican Church in opposition to ultramontanism. But the Vatican council (1870) declared that the pope is superior to all councils; and, when speaking officially on faith and morals, is infallible. This decision has, for the present, overwhelmed the episcopal system in the Rom. Cath. Church.

EPISCOPIUS—EPISODE.

EPISCOPIUS, *ɛp-ɪs-kɔ'pi-ʊs*, SIMON (Dutch name, Bisschop): 1583–1643; b. Amsterdam: head of the Arminian party after the death of Arminius. He studied at Leyden, took his degree 1606, and was ordained pastor of the village of Bleyswyck near Rotterdam 1610. In the following year, the states-general, with the intention of putting an end to the agitations created by the controversies between the Gomarists or Calvinistic party and the Arminians or Remonstrants, ordered a conference to be held in their presence at the Hague between six ministers of each party. E. was one of the six charged with the advocacy of Arminianism, and highly distinguished himself by good temper, ability, and learning. In 1612, the curators of the Univ. of Leyden appointed him prof. of theology in place of Gomar, who had gone to Seeland. This enraged the leaders of the orthodox party, who unscrupulously accused E. of Socinianism, and of having entered into an alliance with the Rom. Catholics for the destruction of Protestantism. By this the fanaticism of the populace was roused; he was insulted and abused in the street, and on one occasion narrowly escaped being stoned to death. The house of his brother in Amsterdam was sacked, under the pretext that it was a rendezvous of the Remonstrants. In 1618, occurred the famous Synod of Dort (q.v.). E. was present, with several other Arminians. The Calvinists, who were in an overwhelming majority, would not allow him to speak; they told him that the synod was met not to discuss, but to judge; and all the proceedings exhibited the bigotry and tyranny to which ecclesiastical tribunals have been deemed liable. Expelled from the church, and banished from the country, E. betook himself first to Antwerp, afterward to Rouen and Paris, but 1626 returned to Rotterdam, where the *odium theologicum* against his party had become less virulent. Here he married in 1630, and four years later was made primarius prof. of divinity in the newly established college of the Remonstrants. E. held enlightened principles in regard to religious toleration. Not placing a high value on merely doctrinal views, but trusting rather to the efficacy of the Christian spirit to elevate and purify the character, and seeing, moreover, the presence of this spirit in men holding the most conflicting opinions (when not inflamed with controversial hates), he was desirous of a broader and more catholic bond of unity among Christians than the opinionative creeds of his day permitted. His chief works are his *Confessio Remonstrantium* (1621), *Apologia pro Confessione* (1629), and *Institutiones Theologicæ*, incomplete. A complete ed. of his works appeared Amsterdam, 2 vols. 1650.

EPISKELETAL, a. *ɛp-i-skɛl'ɛ-tal* [Gr. *epi*, upon; Eng. *skeleton*]: in *anat.*, above the embryonic vertebral axis; name given by Huxley to what Quain calls epiaxial.

EPISODE, n. *ɛp'i-sōd* [F. *épisode*—from Gr. *epeī'sōdōs*, a coming in besides—from *epi*, *eisōdōs*, a coming in—from *eis*, into; *hodos*, a way]: an incidental narrative or digression introduced for the purpose of giving greater variety to the

EPISTOLÆ OBSCURORUM VIRORUM.

events related. EP'ISOD'IC, a. -sōd'ik, or EP'ISOD'ICAL, a. -i-kūl, pertaining to or contained in an episode. EP'ISOD'ICALLY, ad. -li.

EPISPASTIC, a. ēp'i-spās'tik [Gr. *epispastikos*—from *epi*, upon; *spaō*, I draw]: in med., drawing; blistering: N. that which acts as a blister.

EPISPERM, n. ēp'i-spērm [Gr. *epi*, upon; *sperma*, the seed]: in bot., the external covering of the seed. EP'ISPORE, n. -spōr, the outer covering of some spores.

PISTA'XIS, n. ēp'i-stāk'sis [Gr. *epi*, upon; *stāzein*, to drop]: the act or state of bleeding from the nose.

PISTERNA, n. ēp'i-stēr'na [Gr. *epi*, upon; *sternon*, the breast; the chest]: in zool., lateral pieces of the inferior or ventral arc of any somite in a crustacean.

PISTERNAL, a. ēp'i-stēr'nāl [Gr. *epi*, *sternon*, the breast-bone]: situated on or above the sternum or breast-bone. PISTER'NUM, n. -nūm, the upper part of the sternum or breast-bone.

PISTHOTONOS, n. ēp'i-s-thōt'ō-nōs [Gr. *episthen*, forward; *teinō*, I bend or stretch]: in med., a spasmodic affection in which the body is bent forward.

PISTILBITE, n. ēp'i-stīl'bīt [Gr. *epi*, upon; *stīlbē*, lustre]: a crystal of a white, bluish, or yellowish-white color: see STILBITE.

PISTLE, n. ē-pīs'l [L. *epistōlā*; Gr. *epistolē*, anything sent by a messenger—from *epi*, upon; *stellō*, I send: Sp. and It. *epistōlā*]: a letter; a writing or communication to be sent; in the service of some churches, a Scripture lesson read usually from one of the Apostolic speeches, though sometimes from other books of Scripture; a part of the service supposed to be as old as the 6th c. EPIS'TOLARY, a. -tō-lér-i, pertaining to letters or correspondence; contained in letters. EPISTOLIC, a. ēp'i-s-tōl'ic, or EP'ISTOL'ICAL, a. -i-kāl, pertaining to letters or epistles. EPIS'TLER, n. -pīs'lér, old name for the priest who reads the epistle in the Communion Service. EPISTLE SIDE OF THE ALTAR, left side of the altar or communion table (looking from it along the church), at which in the church service the epistle of the day is read. It is of less distinction than the right or gospel side, and is occupied by the clergyman of lower ecclesiastical rank.

| EPISTOLÆ OBSCURORUM VIRORUM, ē-pīs'tō-lē ūbskū-rō'rūm vī-rō'rūm (Lat., Letters of Obscure Men): collection of satirical letters which appeared at the commencement of the 16th c., and professed to be the composition of certain ecclesiastics and professors in Cologne and other places in Rhenish Germany. They were directed against the scholastics and monks, and lashed with merciless severity their doctrines, writings, morals, modes of speech, manner of life, follies, and extravagances, and thus helped to bring about the Reformation. The controversy of Reuchlin with the baptized Jew, Pfefferkorn, concerning Hebrew punctuation, gave the first occasion to the *Epistolæ*, and it is probable that their title itself was suggested by the *Epistolæ Clarorum Virorum ad Reuchlinum Phorcensum*.

PLATE 3.

Epiphylospermous
Ermine



Part of **Epi-**
phylospermop-
us. Frond.



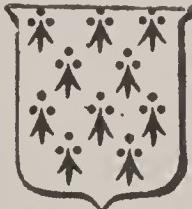
Episperm.—
Section of Seed: a,
The episperm; b,
The endopleura; c,
The endosperm.



Epizoa.——1, *Lerniacerna spratti*,
and (2) Sprat infested with it; 3,
Pandarus bicolor.



Erased.



Ermine.



A Lion's Head Erased.



Erica herbacea.



Erato.—Antique, British
Museum.



**Wool-tree (Erioden-
dron anfractuosum).**

EPISTOME—EPITAPH.

(1514). They were addressed to Octuus Gratius in Deventer, who was far from being so complete an ignoramus as might be supposed from this circumstance, but who had made himself odious to the liberal minds of the time by his arrogant pretensions and his determined hostility to the rising spirit of reform. On the first appearance of the work, it was ascribed to Reuchlin; afterward, to Reuchlin, Erasmus, and Hutten. More recent investigators have inclined to the belief, that the *first* part, which appeared at Hagenau 1515 (but professedly at Venice), was the production of Wolfgang Angst, learned and witty book-printer of that town; but, latterly, doubt has been expressed whether even he had anything to do with the *Epistolæ*. In the composition of the second part (published 1519), Erotus Rubeanus had, after Ulrich von Hutten, the most considerable share. The placing of the *Epistolæ* in the catalogue of forbidden books by a papal bull, helped to spread it. Among numerous editions of the work (1643, 1703, 1827, etc.), the best is by Böcking (1858; 2d ed. 1864). See D. F. Strauss's *Ulrich von Hutten*.

EPISTOME, n. ēp'is'tō-mē [Gr. *epi*, upon; *stoma*, a mouth]: a valve-like organ which arches over the mouth in certain of the polyzoa.

EPISTOMIUM, n. ēp'ī-stō'mī-ūm [Gr. *epistōmīōn*, a gag, a stopple]: the cock or spout of a water-pipe, or of any vessel containing liquids to be drawn off in small quantities when required. **EP'ISTO'MEUS**, a. -ūs, spigot-shaped.

EPISTRÖPHE, n. ē-pīs'trō-fē [Gr. *epistrōphē*, a turning toward, conversion—from *epi*, upon; *strōphē*, a turning]: in *rhet.*, a figure in which each member of a sentence concludes with the same affirmation.

EPISTRÖPHY, n. ē-pīs'trō-fī [Gr. *epistrōphē*, a turning about, conversion—from *epi*, upon; *strōphē*, a turning]: in *bot.*, the reversion of a monstrous or variegated form to a normal one; a mode of distribution of protoplasm and chlorophyl granules on free cell-walls under the action of light.

EPITAPH, n. ēp'ī-tāf [F. *épitaphe*—from L. *epitaphium*—from Gr. *epi*, upon; *taphos*, a tomb, a sepulchre]: inscription on a monument or tombstone in memory or honor of the dead. **EP'ITAPH'IC**, a. -īk, or **EP'ITAPH'IAN**, a. -ī-ūn. **EP'ITAPHIST**, n. a writer of epitaphs.—From originally signifying a monument, this word is now used exclusively to designate the commemorative inscription on a monument or tombstone. This perversion may in some measure have arisen from the remembrance of the funeral orations which the ancients were in the habit of pronouncing at funerals. But the epitaph, in its stricter sense, was well known to the classical nations of antiquity; and, indeed, by every people a brief commemoration of the heroic actions or personal virtues of their illustrious dead has been regarded as one of the worthiest occupations of the faculties of the living. As epitaphs were not only engraved on the most enduring substances, but from their brevity were easily preserved in the memory and orally transmitted, wherever we find the

EPITAPH.

literature of a people at all we are likely to discover specimens of their epitaphs. Pettigrew has translated several from Egyptian sarcophagi (Bohn's edition, p. 5), but they are of no great interest. Herodotus (vii. 228) has preserved to us those which the Amphictyons caused to be inscribed on the columns which they raised in honor of the heroes of Thermopylæ, and that which Simonides, from personal friendship, placed on the tomb of the prophet Megistias. The general inscription for the whole of them was to this effect: 'Four thousand from Peloponnesus once fought on this spot with three hundred myriads;' and that which was special to the Spartans was still more memorable: 'Stranger, go tell the Lacedemonians that we lie here obedient to their commands.' The *Anthologia Graeca*, edited by Brunk, subsequently by Jacobs, contains the largest collection of Greek epitaphs; of these many were translated and published by Bohn, 1854, under the editorial care of Mr. George Burges. Of Roman epitaphs antiquarian museums in many European countries, and in the United States, present numerous examples; for the form in which they were conceived was adopted by our own Romanized forefathers, and many a stone bearing the well-known *D. M. (Diis Manibus)*, or *Siste Viator*, probably covered the remains of those whose veins never contained a drop of Roman blood. A very interesting collection of early Christian epitaphs is in Dr. Charles Maitland's *Church in the Catacombs*, 1846. The naturally epigrammatic turn of the French mind peculiarly adapts it for this species of composition, and in French collections, such as the *Recueil d'Epitaphes*, very felicitous examples are found both in Latin and in French. Of the former may be mentioned the 'Tandem felix!' which the Count de Tenia, who had enjoyed every form of temporal prosperity, caused to be engraved on his tomb; and of the latter, the touching epitaph to a mother, 'La première au rendez-vous.' A large portion of the earlier monuments, and consequently of the epitaphs of Britian, were destroyed at the Reformation, and subsequently by the iconoclastic rage of the Puritans and Presbyterians. But at a later date, no literature, ancient or modern, vies with that of England in this peculiar branch, for while English epitaphs possess the point and terdeness without which no epitaph can be successful, they exhibit a feature almost unknown in those of other nations—that, viz., of wit, or perhaps more properly, of humor. It seems as if the English had found it impossible to confine their raillery to the living, and that it had overflowed upon the tombstones in recalling the harmless peculiarities of the dead. There are many excellent old collections of epitaphs, such as the *Thesaurus Epitaphiorum* of Philip Labbe, Paris 1666. Of modern ones, the best is that of Pettigrew, published by Bohn, arranged to mark the diversity of taste prevailing at different periods of our history. See also the works of Gruter, Græsius, Reinesius, Muratori, Mazochius; the *Monumenta Anglicana*, London 1719; Weever's *Ancient Funeral Monuments, etc.*

EPITASIS—EPITHELIOMA.

EPITASIS, n. *ē-pīt'ā-sīs* [Gr. a stretching—from *epi*, upon, over; *teinō*, I stretch]: in *anc. drama*, that part of a play in which the plot thickens; the part which embraces the main action of the play; opposed to protasis (q.v.).

EPITHALAMIUM, n. *ēp'ī-thă-lă'mi-ūm* [L.—from Gr. *epīthālamion*, that which appertains to the bridal-chamber, the bridal song—from *epi*, upon; *thalāmos*, a bed-room: F. *épithalame*]: nuptial song in honor of the bride and bride-groom. The Greeks and Romans sang such a poem in chorus near the bridal-chamber (*thalamus*) of a newly married pair. Anacreon, Stesichorus, and Pindar composed poems of this kind, but only scanty fragments have been preserved. The E. of Peleus and Thetis by Catullus is one of the finest specimens of Latin poetry extant; but probably the most gorgeous E. in all literature, is that of the English poet Spenser. A collection of Greek and Latin epithalamia is in Wernsdorf's *Poetæ Latini Minores* (IV. part 2).

EPITHECA, n. *ēp'ī-thē'kă* [Gr. *epi*, upon; *thēkē*, a sheath, a box]: a continuous layer surrounding the thecæ in some corals externally. EPITHECIUM, n. *ēp'ī-thē'si-ūm*, the surface of the fructifying disk in certain fungi and lichens.

EPITHELIOMA, n. *ēp'ī-thē'lī-ō'mă* [formed from *epithe- lium*, which see]: epithelial cancer, occurring on tegumentary or mucous surfaces, the lips and cheeks being the parts most commonly affected by it: see EPITHELIUM: CANCER.

EPITHELIUM.

EPITHELIUM, n. *ēp-i-thē'lē-ūm* [Gr. *epi*, upon; *thēlē*, the nipple, or *thallō*, I grow]: in *anatomy*, layer of cells forming the surface of all the internal membranes of the body; in *plants*, a finer epidermis having extremely fine cells filled with colorless fluid, and lining the ovary, etc. **EPITHE'LIAL**, a. -āl, pertaining to or formed of. **EPITHELIATED**, a. *ēp-i-thē'lē-ā-tēd*, covered with a very delicate lining, as a serous cavity, a membrane, etc.—*Epithelium* in anatomy is the cell-tissue which, in layers of various thickness, invests not only the outer surface of the body, and the mucous membranes connected with it—as, for example, those of the nose, lungs, intestinal canal, etc.—but also the closed cavities of the body, such as the great serous membranes, the ventricles of the brain, the synovial membranes of joints, the interior of the heart and of the blood-vessels proceeding to and from it, the ducts of glands, etc.

The thickness of this tissue varies extremely with the position in which it occurs. In some parts it consists of numerous strata of cells, collectively forming a layer of more than a line in thickness; in other parts, it is composed of only a few strata, or often of only a single stratum of cells, and can be detected only by the microscope.

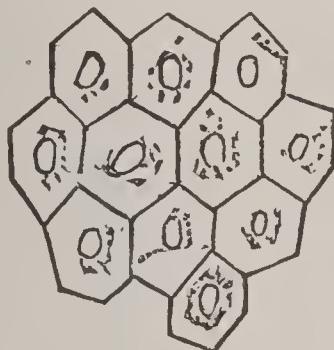


Fig. 1.

Epidermis (still soft like the epithelium of internal parts) of a two months' human embryo. Mag. 350 diam.



Fig. 2.

Epithelial cells of the vessels; the longer one from the arteries, the shorter ones from the veins.

The cells of which the epithelium is composed are usually soft nucleated cells; they may be rounded, polygonal, fusiform, cylindrical, or conical in shape, and sometimes they possess vibratile cilia, the appearance and uses of which are explained below. See CILIA.

(a) *Epithelium in a single stratum* may be composed of—

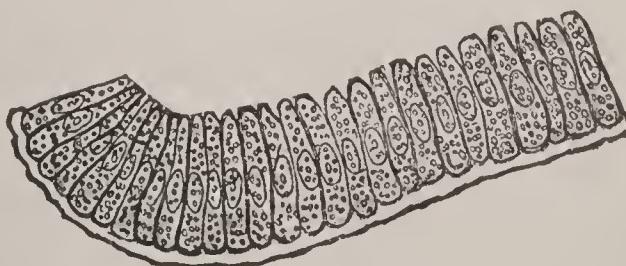


Fig. 3.

Epithelium of the intestinal villi of the rabbit. Mag. 300. diam.

Kölliker, in his *Manual of Human Histology*, adopts the following arrangement. He considers (a) epithelium in a single stratum, and (b) epithelium in many layers.

EPITHELIUM.

1. *Rounded, polygonal cells*, constituting the variety known as pavement or tesselated epithelium, and occurring as an investment of the serous membranes, of most synovial membranes, of the lining membrane of the heart and of the veins, of the canals of glands, etc.

2. *Fusiform, superficially united cells* (fusiform epithelium), as the epithelium of the arteries and of many veins.

3. *Cylindrical cells* (cylinder epithelium), as in the intestine from the stomach to the termination of the alimentary canal, in the excretory ducts of all the glands opening into the intestine, etc. For illustrations of this cylinder epithelium, see DIGESTION, ORGANS AND PROCESS OF.

Fig. 4.
Ciliated cells from the finer bronchial tubes, of the nasal cavities, and of the uterus. Mag. 350 diam.

4. *Cylindrical or conical ciliated cells*, as the epithelium of the more minute bronchial tubes, of the nasal cavities, and of the uterus.

5. *Rounded ciliated cells*, as the ciliated pavement epithelium of the ventricles of the brain in the fetus.

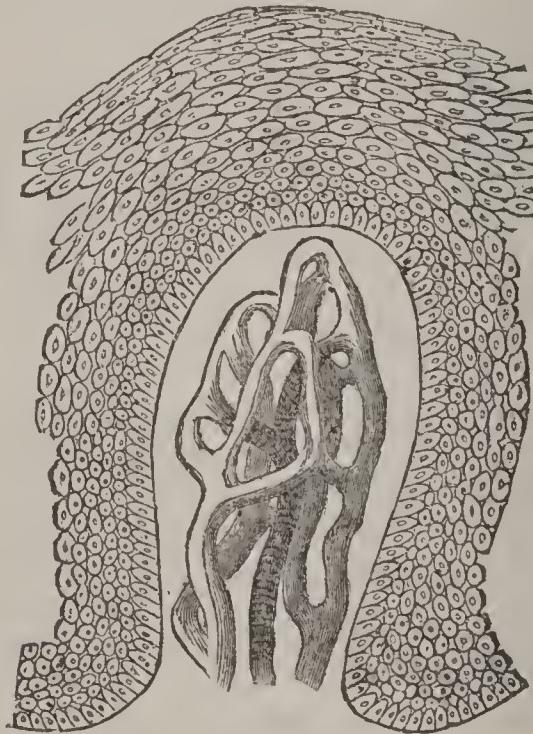


Fig. 5.

Laminated pavement epithelium investing a simple papilla (with blood-vessels in the interior) from the gums of a child. Mag. 250 diam.

(b) *Epithelium in many layers* may be composed of:

1. *Cylindrical or rounded cells below, and more or less flattened cells above.* This is termed laminated pavement epithelium, and occurs in the mouth, lower part of pharynx, œsophagus, bladder, etc.

2. *Rounded cells below, more elongated ones in the middle, and ciliated conical ones above.* This is termed laminated ciliary epithelium, and occurs in the larynx, trachea, and larger bronchial tubes, in the greater part of the nasal cavity, etc.

EPITHELIUM.

In all the varieties of epithelium, the layer of external cells is being constantly disintegrated and replaced by the layer immediately beneath.

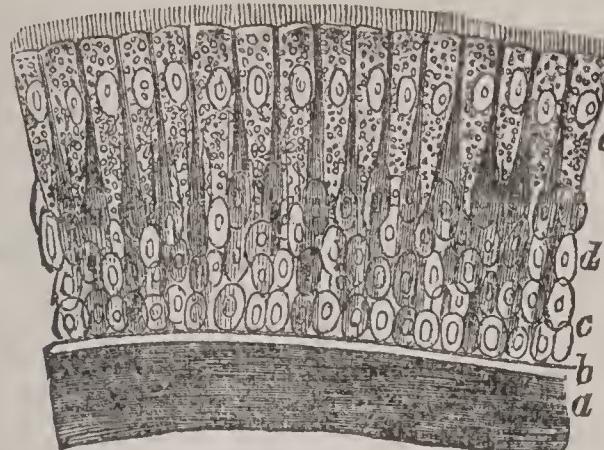


Fig. 6.

Ciliated epithelium from the trachea of a man. Mag. 350 diam. *a*, outermost part of the elastic longitudinal fibres; *b*, homogeneous outermost layer of the mucous membrane; *c*, deepest round cells; *d*, median long cells; *e*, outermost conical ciliated cells.

The uses of the chief varieties of epithelium, especially of ciliated epithelium, are as follows:

The polygonal or pavement of epithelium mainly acts like the epidermis, as a protecting medium to the soft parts beneath.

The cylindrical epithelium additionally takes an active part in the process of secretion. For illustrations of the function of the cells forming this variety of epithelium, see CELLS, ANIMAL; DIGESTION, ORGANS AND PROCESS OF; further see SECRETION.

In connection with ciliated epithelium, *ciliary motion* generally, so far as it occurs in the animal kingdom, is to be noticed. Certain surfaces which are lubricated by a fluid, are covered with a multitude of hair-like processes of extreme delicacy and minuteness (their length varying from $\frac{1}{1000}$ to $\frac{1}{2000}$ of an inch), which from their shape are termed *cilia*, from *cilium*, an eyelash (see CILIA). During life, and for a certain period after death, these filaments exhibit a remarkable movement, each cilium bending rapidly in one direction, and rapidly returning to its original position (according to Krause, these movements range from 190 to 230 in a minute). On examining a ciliated surface with a high magnifying power, the motion presents an appearance somewhat resembling that of a cornfield agitated by a steady breeze. Any minute objects coming in contact with the free extremities of the cilia are urged onward in the direction of the predominant movement; and the best method of observing the course of the ciliary current is to sprinkle the surface with a little powdered charcoal, grains of which may speedily be seen to move onward in a definite direction.

An easy way to observe this phenomenon is to detach, by scraping with a knife, a small piece of epithelium from the back of the throat of a living frog. The scales, moistened with water or serum, will continue to exhibit the

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movement of their adherent cilia for a considerable time, provided the piece be kept duly moistened. On one occasion, a piece prepared in this way by Mr. Bowman and Dr. Todd exhibited motion for 17 hours; and it would probably have continued longer, had not the moisture around it evaporated; and if the epithelium is not removed from the body of an animal that has been killed, the motion continues much longer. In a turtle, after death by decapitation, it lasted, in the mouth, 9 days; in the trachea and lungs, 13 days; and in the œsophagus, 16 days. In man and mammals, it seldom lasts two days, and usually ceases much sooner. The necessary condition for their movement appears to be the integrity of the cells to which they are attached; for as soon as these shrink up for want of moisture, or undergo any physical change, the cilia cease their characteristic action. We know nothing regarding the mechanism or source of ciliary motion, except that (as it continues on detached epithelium) it is independent of both the vascular and nervous systems.

This phenomenon exists very widely throughout the animal kingdom. Dr. Sharpey, in his article *CILIA* (published more than 40 years ago, *Cyclopædia of Anatomy and Physiology*) notices its occurrence in the Infusoria, in Polyps and their ova, in Acalephæ, Actiniæ, Echinodermata, Annelida, Molluska, and the Molluscoids (e.g., Ascidiants), in Reptiles, Birds and Mammals. Since the date of that article, it has been discovered in Sponges, and in one or two exceptional cases in Fishes; but it has never been found in any part of the body of Articulata (Crustaceans, Insects, or Arachnidans). The parts on which it occurs are (1), the skin or surface of the body, (2) the respiratory, (3) the alimentary, and (4) the genito-urinary systems; and it has been observed in the ova of numerous classes of animals, from Reptiles downward to Infusoria. In most of the parts in which we observe it, its use appears to be of a mechanical nature—viz., to convey the fluids or other matters along the surfaces on which the cilia exist, or, as in the Infusoria, to carry the entire animal through the water.

1. Cilia have been found on the external surface in Batrachian larvæ, in Mollusca, Annelida, Echinodermata, Actiniæ, Medusæ, Polypi, and Infusoria. In most cases, their function is respiratory, but in many instances it is also locomotive or prehensile.

2. Ciliary motion has been observed on the lining membrane of the air-passages of Mammals, Birds, and Reptiles, where, whatever may be its other uses, it serves to convey the secretions along the membranes, together with any foreign matter that may be present. It exists also on the external gills of Batrachian larvæ, and on the respiratory organs of Molluska and Annelida. The cilia which exist externally on still lower animals without separate respiratory organs, assist in the respiratory process, by renewing the water on the surface.

3. It occurs in the mouth, throat, and gullet of various reptiles, and in the alimentary canal of the Mollusca, Echinodermata, many Annelida, and Acalephæ. It is not

EPITHEM—EPITROCHOID.

easy, as Dr. Sharpey observes, to see the purpose of the motion in all these cases. In some, it may merely convey secreted matters along the surface of the lining membrane; and in others it seems to serve in place of ordinary deglutition, to carry food into the stomach.

4. It is observed on the surface of the reproductive organs of Mammals, Birds, and Reptiles. From the direction of the current being from without inward, the office of the cilia may be to hurry down the ovum, in addition to removing the mucous secretion of the membrane.

In Reptiles and Fishes, ciliary motion exists at the neck of each uriniferous tube. The movement is directed toward the tube, and favors the flow of the watery portion of the secretion toward it.

There are some situations, both in man and the lower animals, in which it is difficult to determine what functions the ciliary motion can perform, as, for example, in man, in the ventricles of the brain; and in the frog, in the closed cavities of the pericardium and peritoneum.

EPITHEM, n. *ĕp'i-thĕm* [Gr. *epithēmā*, that which is laid upon a thing—from *epi*, upon; *tithēmī*, I place]: in *med*, a liquid in which cloths may be dipped to be laid on any part of the body; a poultice.

EPITHET, n. *ĕp'i-thĕt* [L. *epithēton*, an epithet—from Gr. *epithētōs*, added or put to, annexed—from *epi*, upon; *tithēmī*, I place]: a word which expresses some real quality of the thing to which it is applied. **EPITHETIC**, a. *-ĭk*, pertaining to; abounding with epithets—**SYN.** of ‘epithet’: title; appellation; adjective.

EPITITHIDES, n. *ĕp-i-tīth'ī-dēz* [Gr. *epitithēmi*, I place upon, I add; *epi*, upon; *tithēmi*, I place] : in *arch.*, the upper members of the corona surmounting the fastigium of a temple, which was also continued along the flanks.

EPITOME, n. *ĕ-pit'ō-mē* [Gr. *epitōmē*, a surface-incision, an abridgment—from *epi*, upon; *temnō*, I cut; *tōmē*, a cutting]: a brief summary or abridgment of any book or writing; an abstract or compendium. **EPITOMIZE**, v. *-mīz*, to reduce a work to a small compass; to shorten or abridge by giving the principal matter. **EPITOMIZING**, imp. **EPITOMIZED**, pp. *-mīzd*. **EPITOMIST**, n. *-mīst*, one who; also **EPITOMIZER**, n.—**SYN.** of ‘epitome’: abridgment; compend; synopsis; digest; summary; draft.

EPITRITE, n. *ĕp'i-trīt* [Gr. *epitritos*, containing an integer and a third, $1 + \frac{1}{3}$ or $\frac{4}{3}$; *epi*, upon; *tritos*, the third]: in *pros.*, a foot consisting of three long syllables and a short one, and denominated first, second, third, or fourth epitrite, according as the short syllable is the first, second, third, or fourth in position, as *sălūtăntēs*, *cōncătăl*, *înteràlăns*, *încăntără*.

EPITROCHOID, n. *ĕp-i-trōk'oyd* [Gr. *epitrochos*, running easily, easily inclined; *epi*, upon; *trochos*, a runner, ball, wheel, or hoop; *eidos*, resemblance]: in *geom.*, curve formed by one circle revolving like a wheel or hoop around the convexity or outer side of the circumference of another

EPITROPE—EPIZOON.

circle. It is akin to the epicycloid, but differs in not having the generating points in the circumference of the revolving circle.

EPITROPE, n. ē-pit'ro-pē, or EPITROPY, n. -pi [Gr. *epitropē*, a yielding, a surrender; *epitrepō*, I turn over to another; I yield; I submit; *epi*, over; *trepō*, I turn]: in *rhet.*, concession; figure of speech by which any point is yielded or granted, with a view to obtain an advantage.

EPIZEUXIS, n. ēp-i-zūks'is [Gr. *epizeugnumi*, to fasten on or together; *epi*, upon; *zeugnumi*, to join]: in *rhet.*, figure of speech by which a word is repeated with vehemence or emphasis: as,

“Alone, alone, all, all, alone,
Alone on a wide, wide sea.”

COLERIDGE: *Ancient Mariner.*

EPIZOON, n. ēp'i-zō'ōn, EPIZOA, n. plu. ēp'i-zō'ā [Gr. *epi*, upon; *zōōn*, an animal]: parasitic animal which fastens itself on the exterior of other animals and lives upon them —opposed to *entozoon* (q.v.). Noticing those only that infest man, we may divide them into two groups: (1) Those which live upon the surface of the skin, and (2) those which live in the skin. Fleas, lice, bugs, ticks, etc., belong to the first group; the Itch-insect or *Surcoptes*, the Pimple-mite or *Demodex folliculorum*, and possibly some other species of the *Acaridae*, to the second.

In a zoological point of view, all the E. that infest the human subject are Insects or Arachnidans. The parasitic insects are: I. *Pulicida*, or *Fleas*, including—1. The Common Flea, or *Pulex irritans*; 2. The Sand-flea, or *Pulex penetrans*, known also as the Chigo, Chigger, etc. II. *Acanthida*, or *Soft Bugs*, including the common Bed Bug, or *Acanthia* (s. *Cimex*) *lectularia*. III. *Pediculida*, or *Lice*, including—1. The Common Louse, or *Pediculus capitis*; 2. The Body Louse, or *Pediculus vestimenti*; 3. The Crab Louse, or *Pediculus* (s. *Phthirius*) *pubis*; 4. The Louse occurring in Phthiriasis, or *Pediculus tabescens*.

The parasitic Arachnidans belong to the order of *Acarida*, or Mites; indeed, most of the animals forming the different families of this order lead a parasitic existence. We have—I. *Demodicida*, including the Pimple-mite or *Demodex* (s. *Acarus*) *folliculorum* (the dog and sheep possess each a special demodex). II. *Sarcoptida*, including the Itch-mite, or *Sarcoptes* (s. *Acarus*) *Scabiei*. (Most of our domestic animals seem to be infested by a special sarcoptes, the species of which are numerous) III. *Ixodida*, or Ticks, including—1. The American Tick, or *Ixodes hominis* (common in Brazil); 2. The Common Wood-tick (Dogs' Tick), or *Ixodes ricinus*. There are probably many species of *Ixodes* which are occasionally found on man. IV. *Gamasida*, or Beetle Lice, including—1. The Bird-mite, or *Dermanyssus avium* (occasionally found on sickly persons); 2. The Miana Bug, or *Argas persicus* (common in some parts of Persia, especially at Miana); 3. The Chincha Bug, or *Argas chinche* (occurring in Columbia). V. *Orobatida*, or Grass-lice, including the Harvest-Bug, or *Leptus autumnalis*. See BUG; FLEA; ITCH-

EPPLICATE—EPPING.

MITE: LOUSE: TICKS. EP'IZOOT'IC, a. -zō-ōt'ik, applied to diseases prevailing among animals at the same time, over considerable tracts of country, corresponding to *epidemic* diseases among men. Like epidemics, such diseases appear to depend upon some peculiar and not well ascertained atmospheric causes; where the cases are neglected or overrowded, they also frequently become contagious; they are apt to take on a low type of fever, and are better treated by supporting than by reducing remedies. Influenza in horses, and pleuropneumonia and vesicular epizootie in cattle, are examples: see CATTLE-PLAQUE: also the references there given. EPIZOOTY, n. ēp'i-zō-ōt-i, the distemper among horses.

EPLICATE, n. ēp'lī-kāt [L. *e*, out, here same as not; *plicatus*, folded, pp. of *plico*, I fold]: in bot., not plaited.

EPOCH, n. ēpōk, or EPOCHA, n. ēpō-kā [mid. L. *epōchā* —from Gr. *epōchē*, a cheek, a pause in the reckoning of time —from *epi*, upon; *échō*, I hold or have: F. *époque*]: in *chronology*, fixed point of time from which succeeding years are numbered (see CHRONOLOGY); period in the progress of events when some important occurrence takes place; a fixed and important period of novelty or change; in *geol.*, age or era (see ERA); in *astron.*, an abbreviation for ‘longitude at the epoch:’ it means the mean heliocentric longitude of a planet in its orbit at any given time—the beginning of a century, for instance. The epoch of a planet for a particular year is its mean longitude at mean noon, Jan. 1, when it is leap year, and Dec. 31 of the preceding year, when it is a common year. The epoch is one of the elements of a planet’s orbit.—SYN. of ‘epoch:’ date; period; era; time; age; generation.

EPODE, n. ēp'ōd [OF. *epode*—from Gr. *epōdōs*, an after-song—from *epi*, upon; *ōdō*, I sing]: the third or last part of an ode. It was the last part of the chorus of the ancient Greeks, which they sang after the strophe and antistrophe, when the singers had returned to their original place: it had its peculiar measure of syllables and number of verses: see CHORUS. EPODIC, a. ē-pōd'ik, pertaining to.

EPONYM, n. ēp'ō-nīm [Gr. *epōnūmī*, a surname—from *epi*, upon; *onūmī*, a name]: the individual who is assumed as the person from whom any race or tribe took its name. EPONYMOUS, a. ē-pōn'i-mūs, giving one’s name to a people, a country, and suchlike; also EPONYMIC, a. ēp'ō-nīm'ik, in same sense. EPONYMY, n. -i-mī, the science or study of eponyms.

EPOPEE, n. ēp'ō-pē' [F. *épopée*—from Gr. *epōpoiū*, epic poetry, the writing of it—from *ēpōs*, discourse; *poiō*, I make]: the history or fable which makes the subject of an epic poem.

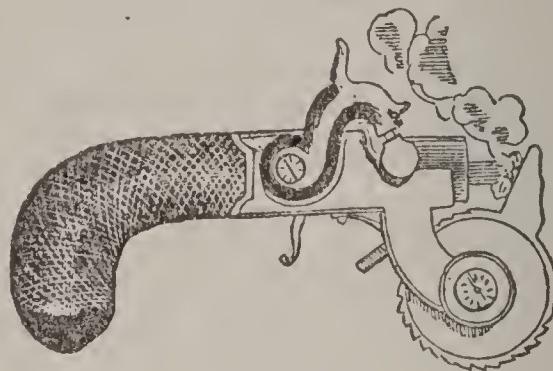
EPOS, n. ēp'ōs [Gr. *epos*, a word, a tale]: an epic poem; the subject or story of an epic poem; epopee.

EPPING, ēp'īng: town in the w. of Essex co., England, in a pleasant healthful situation, at the n. end of Epping Forest, 16 m. n.n.e. of London. It has a very irregular appearance. It is noted for its cream, butter, sausages, and

ÉPROUVE TTE.

pork, and sends much butter to London. Epping Royal Forest, formerly Waltham Forest, where the ancient kings enjoyed much sport, covered all Essex, and extended almost to London. It is now limited to 60,000 acres in the s.w. part of the county. Of this tract, only 12,000 acres are in wastes and woods, the rest being now inclosed as private property. At the cost of about half a million of pounds, 5,600 acres of E. Forest were secured by the corporation of London, and declared free to the public by the queen, 1882, May. These ten sq. m.¹ of almost unbroken woodland form one of the most extensive and beautiful pleasure-grounds in Europe. In the forest is Queen Elizabeth's hunting-lodge. Separated by a stream from E. Forest is Hainault Forest, lately disforested.—Pop. of E. abt. 3,000.

ÉPROUVE TTE, n. *é'prô-vët'* [F.]: a gun, machine, or contrivance of any kind for proving or testing the strength of gunpowder, invented or suggested in the last c. by Robins, and greatly improved by Dr. Hutton.—The *gun* E. determines the strength of gunpowder by the amount of recoil.



Éprouvette.

A small gun, usually a ‘half-pounder,’ is fixed to the lower end of an iron rod; its base being adjusted to an arm projecting from the rod; or it is suspended from an iron frame. A horizontal steel axis is fixed to the rod or frame about which the gun may vibrate. A pointed iron rod or style projects downward from the lower side of the gun, and touches a groove filled with soft wax; the groove is so shaped that, when the gun recoils, the point cuts a path for itself along this wax; and the length of this path determines the amount of recoil. Sometimes a brass graduated arc with an index is used instead of the pointed style and the waxed groove; but the principle of action is the same. On the arc the recoil should vary from 26° for new fine-grain powder to $20^{\circ} 5'$ for old powder of coarse grain. This system of proof is resorted to annually for the proof of powder in store, to ascertain the amount of deterioration.—The *mortar* E. determines the strength of gunpowder by the distance to which a ball is projected. It is generally a mortar of 8-inch bore, in which 2 to 4 ounces of powder is employed to propel an accurately turned iron shot about 120 yards. Other things being equal, the strongest gunpowder sends the shot to the greatest distance; and this is a usual mode in testing gunpowder supplied from contractors.

The ordinary E. is shaped like a small pistol without a

EPSOM—EPWORTH.

barrel, and having its breach chamber closed by a flat plate connected with a strong spring. On the explosion of the powder against the plate, it is driven back to a distance indexed according to the strength of the powder, and is retained at its extreme state of repulsion by a ratchet wheel.

EPSOM, *ēp'som* (said to have originally been Ebbasham): small market-town on the margin of the Banstead Downs in Surrey, England, 15 m. s.s.w. of London by road, 14 m. by the London and S.-Western railway. The famed sulphate of magnesia springs of E. gave their name to the Epsom Salts formerly manufactured from them. This manufacture has been abandoned from the ease with which these salts can be made artificially from magnesian limestone, or from sea-water. The Royal Medical College, on the Downs, established 1851, provides education for about 170 boys, sons of medical men, and affords a home to decayed members of the profession and their widows. On the Downs, 1½ m. s. of the town, the famous E. horse-races are held yearly; said to have been instituted by Charles I., but of greater importance since the institution of the Derby Stakes 1780 (see DERBY DAY). The races last four days, and as many as 100,000 persons often assemble to witness the most important of them.—Pop. (1881) 6,916 ; (1891) 8,417.

EP'SOM SALT, or EPSOMITE, or SUL'PHATE OF MAGNE'SIA ($MgO + SO_3HO$): mineral occurring in the water of mineral springs, as at Epsom, Seidlitz, and many other places; also as an efflorescence on various rocks, sometimes with alum, as at Hurlet, in Renfrewshire; and on the ground, as in some parts of Spain and of the Russian steppes. It is sometimes snow-white and very pure, sometimes discolored by impurities; and is either in fine thread-like crystals, or in crusts, flakes, granules, etc. Its crystals are prisms, almost rectangular. For purposes of commerce, it is now obtained by the action of dilute sulphuric acid upon magnesian limestone: see MAGNESIUM.

E. S. is a well-known purgative in household medicine. It may be given in doses from two drachms to one ounce, according to the effect required, in a tumbler of water.

EPULIS, n. *ēp'ū-līs* or *ē-pū'līs* [Gr. *epi*, upon; *oulon*, gum]: a tumor of the gum, often connected with a carious tooth.

EPULOTIC, a. *ēp-u-lōt'ik* [Gr. *epoulōtikos*—from *epouloō*, to scar over; *epi*, over; *oulē*, a wound healed over; a scar; *oulos*, whole, sound]: tending to heal or cicatrize; cicatrizing: N. a preparation which has the property of healing, drying, or cicatrizing wounds.

EPURÆA, n. *ēp-ūr-ē'a* [Gr. *epouraīos*, on the tail; *epi*, upon; *oura*, tail]: in entom., genus of beetles, family *Nitidulidae*.

EPWORTH, *ēp'wōrth*: town in the n.w. of Lincolnshire, England, 30 m. n.n.w. of Lincoln. It consists chiefly of one street, more than 2 m. long. The chief employments are hemp and flax dressing, rope-making, and malting.

EPWORTH LEAGUE—EQUANIMITY.

John Wesley, founder of Methodism, as well as Kilham, founder of the seceding Wesleyans, was born here. Pop. 3,000.

EPWORTH LEAGUE: assoc. of young people connected with the Meth. Episc. Church, organized 1889, May, by forming a union of the various young people's societies of the church then in existence, and named after the birthplace of John Wesley. Its objects are to promote piety among the young members and friends of the church, to aid them in religious development, and to train them practically in works of mercy and help; and this is accomplished by means of the weekly prayer-meeting and the 'intellectual' and 'mercy and help' departments. It is sustained by voluntary offerings, has a weekly organ, the *Epworth Herald*, published in Chicago, Ill., and 1902 had 29,600 chapters or societies, and 2,000,000 members. The Meth. Episc. Church, S., has organized 5,838 chapters; German Methodist 500 chapters; the Scandinavian and Danish 300 chapters and there are 150 chapters in India, 36 in China and Japan, and 30 in Mexico. A Canadian League has recently been organized, and there is also a Junior League with 250,000 members. In 1895 the League raised \$50,000 for the missions of the church, and about 100,000 members joined the church through this organization.

EPYORNIS: see *AEPYORNIS*.

EQUABLE, a. *ēk'wū-bl* [L. *æquābilis*, that may be made equal—from *æquus*, equal: It. *equabile*]: smooth and uniform; even; steady; unruffled. **EQUABLY**, ad. *-bli*. **EQUABILITY**, n. *-bil'i-ti*, continued equality; equality in motion; uniformity; evenness; also **EQUABLENESS**, n. *-bl-nēs*. **EQUABLE MOTION**, that by which equal spaces are passed over in equal times. **EQUAL**, a. *ē'kuōl* [L. *æquālis*, equal]: being of the same magnitude or extent; having the same value; possessed of the same qualities or condition; having the same benefits; in just proportion; not varying, as temper; adequate to: N. one not inferior or superior to another; one of the same age, rank, fortune, etc.: V. to make or to be of the same kind, rank, quality, etc., as another; to answer in full proportion. **E'QUALLING** or **E'QUALLING**, imp. **E'QUALLED** or **E'QUALED**, pp. *-kwōld*. **E'QUALLY**, ad. *-li*. **EQUALITY**, n. *ē-kwōl'i-ti*, similarity or likeness in regard to two things compared; the same condition or dignity; uniformity; evenness (see **LIBERTY**, **EQUALITY**, **FRATERNITY**). **E'QUALIZE**, v. *-iz*, to make equal. **E'QUALIZING**, imp. **E'QUALIZED**, pp. *-īzd*. **E'QUALIZER**, n. *-zēr*, one who. **E'QUALIZA'TION**, n. *-ī-zā'shūn*, the act of making equal; the state of being equalized. **E'QUALNESS**, n. *-nēs*, state of being equal; evenness.—**SYN.** of 'equal, a.': equable; uniform; even; level; proportionate; adequate; fair; just; commensurate; equitable; like; alike; plain; fit; balanced; unbiased.

EQUAL, EQUALIZE: see under **EQUABLE**.

EQUANIMITY, n. *ē'kwū-nīm'i-ti* [L. *æquānim'itas*, calmness — from *æquus*, equal; *animus*, mind: It. *equanimita*]: evenness of mind; uniformity and steadiness of temper.

EQUATION.

EQUATION, n. *ē-kwā' shūn* [F. *équation* --from L. *aqua-tiōnem*, equal distribution—from *equus*, equal—akin to Skr. *ekas*, one]: a making equal; in *alg.*, a proposition asserting the equality of two quantities, having the sign = (equal to) placed between them. **EQUATE**, v. *ē-kwāt'*, to reduce to an equation; to reduce to mean time or motion. **EQUATED**, a. reduced or corrected, as an astronomical observation. **ANNUAL EQUATION**, one of the most conspicuous of the subordinate fluctuations in the moon's motion, due to the action of the sun, which increases with its proximity to the earth and her satellite. It consists in an alternate increase and decrease in her longitude, corresponding with the earth's situation in its annual orbit, i.e., to its angular distance from the perihelion, therefore having a year instead of a month, or aliquot part of a month, for its period. For explanation of the mode of its production, see Herschel's *Outlines of Astronomy*, art. 738 *et seq.* **DIFFERENTIAL EQUATION**, equation involving differential coefficients (see **CALCULUS**); such is $\frac{d^3y}{dx^3} + a \frac{dy}{dx} = x$; from which it is required to find the relation between y and x . The theory of the solution of such equations is an extension of the integral calculus, and is a branch of study of the highest importance. **FUNCTIONAL EQUATION**: see **FUNCTIONS**.—**LUNAR EQUATION**: see **LUNAR THEORY**.—**EQUATION OF EQUINOXES**, difference between the true position of the equinoxes, and the position calculated on the supposition that their motion is uniform: see **PRECESSION**. **EQUATOR**, n. *ē-kwā'tér*, or **TERRESTRIAL EQUATOR**, the supposed or imaginary great circle which passes round the middle of the earth's surface at an equal distance from both poles, and which divides the earth into north and south hemispheres. **CELESTIAL EQUATOR**, the great circle in the sky, corresponding to the extension of the equator of the earth. **EQUATORIAL**, a. *ē-kwā-tō'rī-äl*, pertaining to the equator or regions about it: N. an astronomical telescope. **EQUATORIALLY**, ad. -*lī*. **EQUATORIAL CURRENT**, the great ocean-current which manifests itself within the equatorial regions of the Atlantic, Pacific, and Indian oceans, having a decided western flow, and warmer by several degrees than the adjacent waters.

EQUATION: an algebraical sentence stating the equality of two algebraical expressions, or of an algebraical expression to zero. From another point of view, E. is the algebraical expression of the conditions which connect known and unknown quantities. Thus (1), $xy = 24$, and (2), $x^2 + y^2 = 52$, are two equations expressing the relations between the unknown quantities x and y and known quantities. Generally, equations are formed from observations from which an object of inquiry may be inferred, but which do not directly touch the object. Thus, suppose we wish to ascertain the lengths of the sides of a rectangular board which we have no means of measuring, and that all the information that we can get respecting it is, that it covers 24 sq. ft., and that the square on its diagonal is 52 sq. ft. From these facts, we can form equations from which we may determine the lengths of the sides. In the first place,

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we know that its area is equal to the product of its sides, and if we call these x and y , we have $xy = 24$, the first of the equations above given. Again, we know that the sum of the squares on the sides is equal to the square on the diagonal; hence, we have the second equation, $x^2 + y^2 = 52$. From these two equations, we should be able to determine the values of x and y . The determination of these values is called the *solution* of the equations.

Equations are of several kinds. A simple E. contains the unknown quantity in the first degree; e.g., $\frac{x}{2} + 3 = 4$. A quadratic E. contains the unknown quantity in the second degree; e.g., $x^2 + 5x - 36 = 0$. Cubic and bi-quadratic equations involve the unknown in the third and fourth powers respectively. For the higher equations there are no special names; they are said to be equations of the degree indicated by the highest power of the unknown which they contain. Simultaneous equations involve two or more unknown quantities, and there must always be as many of them, in order to their determinate solution, as there are unknown quantities. The equations first mentioned—viz., $xy = 24$, $x^2 + y^2 = 52$ —are simultaneous equations. It may be mentioned that in the course of solving such equations the principal difficulties encountered are always ultimately the same as in the solution of equations containing only one unknown quantity. For instance, in the equations just given, if we substitute in the second the

value of y as given by the first, or $y = \frac{24}{x}$, we have $x^2 + \frac{(24)^2}{x^2} = 52$,

which may be solved as a quadratic equation. The general theory of equations, then, is concerned principally with the solution of equations involving one unknown quantity only, for to this sort all others reduce themselves. Indeterminate equations are such as do not set forth sufficient relations between the unknown quantities for their absolute determination, and which accordingly admit of various solutions. Thus, $xy = 24$ is an indeterminate equation, which is satisfied by the values $x = 13$, $y = 8$; or $x = 3$, $y = 4$; or $x = 2$, $y = 12$. We require some other relation, such as $x^2 + y^2 = 52$, to enable us to fix on one of the sets of values, x and y , as those of x . For other kinds of equations, see EXPONENT AND EXPONENTIAL: FUNCTIONS: DIFFERENCE.

The object of all computation is the determination of numerical values for unknown quantities, by means of the relations which they bear to other quantities already known. The solution of equations, accordingly, or, in other words, the evolution of the unknown quantities involved in them, is the chief business of algebra. But so difficult is this business, that, except in the simple cases where the unknown quantity rises no higher than the second degree, all the resources of algebra are as yet inadequate to effect the solution of equations in general and definite terms. For equations of the second degree, or quadratic equations, as they are called, there is a rigorous method of solution.

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by a general formula ; but as yet no such formula has been discovered for equations even of the third degree. It is true, that for equations of the third and fourth degrees general methods exist, which furnish formulas which express under a finite form the values of the roots : see CARDAN: CUBIC EQUATIONS. But all such formulas are found to involve *imaginary* expressions, which, except in particular cases, make the actual computations impracticable till the formulas are developed in infinite series, and the imaginary terms disappear by mutually destroying one another. What is called Cardan's formula, for instance (and all others are reducible to it), is in this predicament whenever the values of the unknown quantity are all real ; and accordingly, in nearly all such cases, the values are not obtainable from the formulæ directly, but from the infinite series of which they are the compact expression. But though such formulæ as Cardan's are useless for the purpose of numerical computation, the search for them has led to most of the truths which constitute the general theory of equations, and through which their *numerical solution* may be said to have been at last rendered effective and general. This method of numerical solution is a purely arithmetical process, performed upon the *numerical coefficients* of equations, and it is universally applicable, whatever the degree of the E. may be. With this method are connected the names of Budan, Fourier, Horner, and Sturm: see Young's *Theory and Solution of Algebraical Equations of the Higher Orders*; Peacock's *Treatise on Algebra*; and La Grange's work on *Numerical Solutions*.

The rules for the solution of the simpler forms of equations are in all elementary text-books of algebra. It must suffice to notice here a few of the leading general properties of equations. By the roots of an E. are meant those values real or imaginary of the unknown which satisfy the equality ; and it is a property of every E. to have as many roots and no more as there are units in its degree. Thus, a quadratic E. has two roots; a cubic E., three; and a biquadratic, four. The quadratic E. $x^2 + 5x - 36 = 0$ has two roots, + 9 and - 4, which will be found to satisfy it. Further, the expression $x^2 + 5x - 36 = (x - 9)(x + 4) = 0$; and generally if the roots of an E.

$$F(x) = x^n \pm A_{n-1}x^{n-1} \pm A_{n-2}x^{n-2} \pm \dots \\ \pm A_1x \pm A_0 = 0$$

(to which general form every E. of the n th degree can be reduced), are

$$\begin{aligned} & \pm a_1 \pm a_2 \pm a_3 \dots \pm a_n \dots \\ \text{then} \quad & (x \mp a_1)(x \mp a_2)(x \mp a_3) \dots \\ & (x \mp a_n) = F(x) = 0. \end{aligned}$$

Hence, and from observing the way in which, in the multiplication of these factors, the coefficients

$$A_{n-1}, A_{n-2} \dots A_1, A_0$$

are formed, we arrive at the following important results :

A_{n-1} = the sum of the roots, with their signs changed,

EQUATION—EQUATION OF PAYMENTS.

A_{n-2} = the sum of the products of every two roots, with their signs changed.

A_{n-3} = the sum of the products of every three roots, with their signs changed.

A_0 = the product of the roots, with their signs changed.

The factors, it will be observed, are formed thus: If $+a_1$ be a root, then $x = a_1$, and $x - a_1 = 0$ is the factor. If the root were $-a_1$, then $x = -a_1$; and the factor would be $x + a_1 = 0$. Observing now the way in which, in multiplying a series of such factors, the coefficients of the resulting polynomial are formed, we arrive at this: that a complete E. cannot have a greater number of positive roots than these *changes* of sign from + to - and from - to + in the series of terms forming its first member; and that it cannot have a greater number of negative roots than there are *permanencies* or repetitions of the same sign in proceeding from term to term. From the same source, many other general properties of equations, or value in their arithmetical solution, may be inferred.

EQUATION, PERSONAL: in Astronomy, the correction of errors in recording the results of observations of an identical event by two or more observers. The errors most likely to occur are in the time-records of an event, some observers recording it a few seconds before its actuality, others shortly afterward. As the work of regular observers is too valuable to be discarded, their records may be utilized in computations when the amount of their average personal errors has been ascertained; and this is done by carefully examining a reasonable number of records of the same event or events by two or more observers, and indicating the average difference between their records.

EQUATION OF LIGHT: in astronomical observations, the allowance to be made for the *time* occupied by the light in traversing a variable space. The visual ray by which we see any body is not that which it emits at the moment of our seeing it, but that which it *did* emit some time before, viz., the time occupied by light in traversing the space which separates it from us. If, then, the body be in motion, its aberration, as due to the earth's velocity, must be applied as a correction, not to the line joining the earth's place at the moment of observation with that occupied by the body (as seen) at the same moment, but at that antecedent moment when the ray quitted it. Hence is derived a rule applied by astronomers for the rectification of observations made on a moving body, viz., from the known laws of its motion and the earth's, calculate its relative angular motion in the time taken by light to pass from it to the earth. This motion is the total amount of its apparent displacement. Its effect is to displace the body in a direction contrary to its apparent motion, an effect one part of which is due to aberration, properly so called (see ABER-RATION), resulting from the composition of the motions of the earth and of light, and another part to the fact of the passage of light occupying time.

EQUATION OF PAYMENTS: arithmetical problem

EQUATION OF TIME.

—to find a time when, if a sum of money be paid by a debtor, which is equal to the sum of several debts payable by him at different times, no loss will be sustained by either the debtor or creditor. The rule generally given is as follows: Multiply each sum due by the time at which it is payable, and then divide the sum of the products by the sum of the debts: the quotient is the equated time. For example, if £10 be due at one month, and £20 at two months, find as an equivalent when the whole £30 may be paid at once. Ans. $\frac{10 \times 1 + 20 \times 2}{30} = 1\frac{2}{3}$ months. This

rule, however, is incorrect where the debts are unequal, because it takes no account of the balance of interest and discount. A correct rule for the case of two debts and simple interest is subjoined. Let d and D denote the debts, t and T the times of payment, and r one year's interest on D .

Then if $A = T + t + \frac{D + d}{dr}$, and $B = Tt + \frac{DT + dt}{dr}$, the

equated time will = $\frac{1}{2}A - \frac{1}{2}\sqrt{(A^2 - 4B)}$. When three or

more debts are concerned, the plan is to find by this formula the equated time for the first two, and then for their sum payable at their equated time, and the third, and so on. The common rule is, however, sufficiently correct for ordinary use.

EQUATION OF THE CENTRE: addition or subtraction of the quantity by which the true and the mean longitude of the earth differ. If the earth moved uniformly round the sun in a circle, it would be easy to calculate its longitude or distance from the line of equinoxes at any time. One year would be to the time since the vernal equinox as 360° to the arc of longitude passed over. But the orbit of the earth is not circular, nor is its motion uniform; the orbit is slightly elliptical, and the motion is quicker at perihelion than at aphelion. The true rule, then, for ascertaining the earth's longitude is contained in the following proportion: one year is to the time elapsed as the whole area of the earth's orbit is to the area swept over by the radius vector in the time. This is a deduction from Kepler's law (see CENTRAL FORCES), that, in planetary motion, equal areas (not angles) are swept over in equal times. The area swept over being ascertained from the laws of the earth's motion, and the elements of its orbit, it is a question of geometry to ascertain the angle corresponding to the area, or the true longitude. In astronomy, the longitude, as calculated on the supposition that the earth moves uniformly in a circle, is called the *mean longitude* of the earth; and it happens, from the orbit being but slightly different from a circle, that the mean and true longitude differ but slightly. By the *equation of the centre*, this difference is sometimes to be added to, sometimes to be subtracted from, the mean longitude, to obtain the true; and sometimes it is zero.

EQUATION OF TIME: addition or subtraction of the difference between apparent and mean time. Under EQUA-

EQUATORIAL.

TION OF THE CENTRE (q.v.) it is noted that the earth's motion in the ecliptic—or what is the same, the sun's apparent motion in longitude—is not uniform. This want of uniformity would of itself obviously cause an irregularity in the time of the sun's coming to the meridian on successive days; but besides this want of uniformity in the sun's apparent motion in the ecliptic, there is another cause of inequality in the time of its coming on the meridian—viz., the obliquity of the ecliptic to the equinoctial. Even if the sun moved in the equinoctial, there would be an inequality in this respect, owing to its want of uniform motion; and even if it moved uniformly in the ecliptic, there would be such an inequality, owing to the obliquity of its orbit to the equinoctial. These two independent causes jointly produce the inequality in the time of its appearance on the meridian, the correction for which is the equation of time.

When the sun's centre comes to the meridian, it is apparent noon, and if it moved uniformly on the equinoctial, this would always coincide with *mean noon*, or 12 o'clock on a good solar clock. But from the causes above explained, mean and apparent noon differ, the latter taking place sometimes as much as $16\frac{1}{2}$ minutes before the former, and at others as much as $14\frac{1}{2}$ minutes after. The difference for any day (called the equation of time) is stated in ephemerides for every day of the year. It is nothing or zero at four different times in the year, at which the whole mean and unequal motions exactly agree—viz., about Apr. 15, June 15, Aug. 31, and Dec. 24. At all other times, the sun is either too fast or too slow for clock-time. In the ephemerides above referred to, the sign + or — is prefixed to the equation of time, according as it is to be added to or subtracted from the apparent time to give the mean time: see NAUTICAL ALMANAC.

EQUATO'RIAL: important astronomical instrument, by which a celestial body may be observed at any point of its diurnal course. It consists of a telescope attached to a graduated circle, called the declination circle, whose axis penetrates at right angles that of another graduated circle called the hour circle, and is wholly supported by it. The pierced axis, which is called the principal axis of the instrument, turns on fixed supports; it is pointed to the pole of the heavens, and the hour circle is of course parallel to the equinoctial. In this position, it is easy to see that a great circle of the heavens corresponding to the declination circle, passes through the pole, and is an hour circle of the heavens. The telescope is capable of being moved in the plane of the declination circle. If, now, the instrument be so adjusted that the index of the declination circle must point to zero when an equatorial star is in the centre of the field of view of the telescope, and the index of the hour circle must point to zero when the telescope is in the meridian of the place, it is clear that when the telescope is directed to any star, the index of the declination circle will mark the declination of the star; and that on the other circle its right ascension. If the telescope be clamped when direct-

EQUERRY—EQUESTRIAN ORDER.

ed on a star, it is clear that, could the instrument be made to rotate on its principal axis with entire uniformity with the diurnal motion of the heavens, the star would always appear in the field of view. This rotation is communicated to the instrument by clock-work.

EQUERRY, n. *ěk'wér-i*, also spelled **EQ'UERY** [F. *écurie*, a stable—from OF. *escuyer*, a squire who attended on a knight, part of whose duties was to look after his master's horse—from mid. L. *scūriū*, stables, a barn: O.H.G. *seura*, an outhouse: F. *escuyrie*, a squire's place]; an officer in a prince's household who has the care of the horses, and attends him in public.

EQUESTRIAN, a. *ě-kwěs'trě-ăñ* [L. *equestris*, belonging to horsemen—from *equès*, a horseman: F. *équestre*]: pertaining to horses or horsemanship; being on horseback; denoting an order of anc. Roman knights: N. a skilful rider on horseback. **EQUES'TRIANISM**, n. *-ăñ-izm*, skilful or professional riding on horseback; the art or recreation of riding (see HORSEMANSHIP). **EQUESTRIAN STATUE**, representation of a man on horseback. Equestrian statues were awarded as a high honor to military commanders and persons of distinction in Rome, and latterly were, for the most part, restricted to the emperors, the most famous in existence being that of Emperor Marcus Aurelius, now in the Piazza of the Capitol at Rome. It is the only ancient equestrian statue in bronze that has been preserved; an exemption which it probably owed to the fact that for centuries it was supposed a statue of Constantine. The action of the horse is so fine, and the air of motion so successfully given to it, that Michael Angelo is said to have called out to it ‘*Cammina!*’—(Go on, then!). It was originally gilt, and traces of the gilding are still visible on the horse's head. So highly is this statue prized, not only for its artistic but its historical value, that an officer used regularly to be appointed by the Roman govt. to take care of it, under the designation of the *Custode del Cavallo*. On the occasion of the rejoicings by which Rienzi's elevation to the tribuneship was celebrated 1347, wine was made to run out of one nostril and water out of the other of this famous horse. The statue then stood in front of the Church of St. John Lateran, near to which it was found, and a bunch of flowers has always been presented annually to the chapter of that basilica, in acknowledgment of ownership, since it was removed to its present site on the capitol. All European capitals are adorned, or disfigured, by numerous equestrian statues, London belonging pre-eminently to the latter category. They are seen also in some principal cities of the United States.

EQUES'TRIAN ORDER, or **EQUITES**, *ěk'wě-tēz*: originally the cavalry of the Roman army; said to have been instituted by Romulus, who selected from the three principal Roman tribes 300 equites. This number was afterward gradually increased to 3,600, partly of patrician partly of plebeian rank, required to possess a certain amount of property. Each of these equites received a horse from the

EQUI—EQUIDÆ.

state; but about B.C. 403, a new body of equites began to appear, who were obliged to furnish a horse at their own expense. These were probably wealthy *novi homines*, men of equestrian fortune, but not descended from the old equites (for it should be observed that the equestrian dignity was hereditary). Until B.C. 123, the equites were exclusively a military body; but in that year Caius Gracchus carried a measure, by which all the *judices* had to be selected from them. Now, for the first time, they became a distinct order or class in the state, and were called *Ordo Equestris*. In B.C. 70, Sulla deprived them of this privilege; but their power did not then decrease, as the forming of the public revenues appears to have fallen into their hands. After the conspiracy of Catiline, the E. O., which on that memorable occasion had vigorously supported the Consul Cicero, began to be looked upon as a third estate in the Republic; and to the title of *Senatus Populusque Romanus* was added *et Equestris Ordo*. But, even in the beginning of the empire, the honor, like many others, was so indiscriminately and profusely conferred, that it fell into contempt, and the body gradually became extinct. As early as the later wars of the Republic, the equites had ceased to constitute the common soldiers of the Roman cavalry, and figure only as officers.

EQUI, *ē'kwī* [L. *æquus*, equal]: a prefix meaning equal, alike—as, **EQUILATERAL**, equal-sided. **EQUIVALVED**, having both valves alike. *Note*.—The words of which *equi* forms the prefix are mostly self-explanatory.

EQUIANGULAR, a. *ē'kwī-āng'gū-lér* [L. *æquus*, equal; *angulus*, a corner or angle], having equal angles. A figure is said to be equiangular all whose angles are equal to one another, as a square, or any regular polygon. Also triangles and other figures, whose corresponding angles are equal, are said to be equiangular one with another.

EQUIDÆ, *ēk'wī-dē* or *ē'kwī-dē* (or *Solidungula*): family of mammalia of the order *Ungulata*, sub-order *Perissodactyla*; containing only a small number of species, which so nearly resemble each other that almost all naturalists agree in referring them to one genus, *Equus*. They are distinguished from all other quadrupeds by the complete consolidation of the bones of the toes, or the extraordinary development of one toe alone in each foot, with only one set of phalangeal and of metacarpal or metatarsal bones, and the extremity covered by a single undivided hoof. There are, however, two small protuberances (*splint bones*) on each side of the metacarpal or metatarsal bone (*canon* or *cannon bone*), which represent other toes. The E. have six incisors in each jaw, and six molars on each side in each jaw; the males have also two small canine teeth in the upper jaw, sometimes in both jaws, which are almost always wanting in the females. The molars of the E. have square crowns, and are marked by laminæ of enamel with ridges forming four crescents. There is a wide space between the canine teeth and the molars. The stomach of the E. is simple, but the intestines are long, and the cæcum extremely large; the digestive

EQUIDIFFERENT—EQUINIA.

organs being thus very different from those of the ruminants, but exhibiting an equally perfect adaptation to the same kind of not easily assimilated food. Another distinctive peculiarity of the E. is, that the females have two teats situated on the pubes, between the thighs. But notwithstanding these characters, so dissimilar to those of the ruminants, they approach them very much in their general conformation, and may be regarded as a connecting link between pachyderms and ruminants. The largely developed and flexible upper lip is a character which belongs to the former rather than to the latter order.

The E. are now found in a truly wild state only in Asia and Africa. Fossil remains exist in the newer geological formations in great abundance in many parts of the old world; very sparingly, however, in the new, though the bones of a peculiar and distinct species (*Equis curvidens*), belonging to the Pleiocene period, have been found in S. America.

The horse and the ass are by far the most important species of this family. The dziggethai also has been domesticated and made useful to man. Of the other species, the zebra, quagga, and dauw, it is generally believed that they are incapable of useful domestication. *EQUUS*, ē'kwūs, n. genus of ungulates, typical of the family *Equidæ*.

EQUIDIFFERENT, a. ē'kwī-dif'fér-ēnt [L. *aequus*, and *different*]: arithmetically proportional.

EQUIDISTANT, a. ē'kwī-dis'tānt [L. *aequus*, equal; *distant* or *distan'tem*, far asunder]: at an equal distance from some point or place. **E'QUIDIS'TANCE**, n. **E'QUIDIS'TANTLY**, ad. -lī.

EQUILATERAL, a. ē'kwī-lāt'ēr-äl [L. *aequus*, equal; *latus*, a side]: having all the sides equal. A square is equilateral. The equilateral hyperbola is that whose axes and conjugate diameters are equal.

EQUILIBRATE, v. ē'kwī-lī'brāt [L. *aequus*, equal; *libratus*, weighed, balanced]: to balance equally two scales, sides, or ends.

EQUILIBRIUM, n. ē'kwī līb'rī-ūm [L. *aequilibriūm*, a horizontal position—from *aequus*, equal; *librā*, a balance]: equality of weight, power, or force, etc; the state of rest or balance of a body or system, solid or fluid, resulting from the action of two opposite and equal forces, or of various forces: see **STATICS**: **HYDROSTATICS**.

EQUIMULTIPLE, n. ē'kwī-mūl'ti-pl [L. *aequus*, equal, and *multiple*]: a number which has been multiplied by the same number or quantity as another: **ADJ.** multiplied by the same number or quantity.

EQUINE, a. ē'kwīn, or **EQUINAL**, a. ē'kwī'nāl [L. *equīnūs*, pertaining to horses—from *equus*, a horse: It. *equino*]: pertaining to horses.

EQUINIA, ē'kwīn'ī-a, or **GLANDERS**, in the Human Subject: disease affecting man, to whom it is transmissible from animals: see **GLANDERS**. It is remarkable that though the disease in the horse and ass has been recognized from the time

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of Aristotle (who describes it as common in the ass), it was not till 1810 that Waldinger of Vienna drew attention to the fact, that special precautions should be taken in the dissection of the horses affected with glanders and farcy, inasmuch as the most serious and often fatal consequences might arise from the inoculation of the morbid matter. Strangely, however, he does not seem to have noticed that the disease thus induced in man is identical with that of the horse; and it was not till 1821 that Schilling recognized this important point. It was not till Dr. Elliotson published his Memoir *On the Glanders in the Human Subject*, 1830, that the attention of the British medical profession was directed to the subject. In 1837, Rayer in his Memoir *De la Morve et du Farcin chez l'Homme*, gave a description of glanders both in the horse and in man; and in 1843, Tardieu published *De la Morve et du Farcin Chroniques*. It is to these writers, and to the brothers Gamgee, in Reynolds's *System of Medicine*, that we owe almost all our knowledge of this terrible disease, one of the maladies lately shown by German investigators to be due to the attacks of a special kind of *Bacterium* (q.v.: see also **GERM THEORY**).

In the great majority of cases, the transmission is from the horse, the ass, or the mule to man; but several instances have been recorded in which it has been transmitted from one human being to another. The disease is no doubt generally due to inoculation, but the virus is probably capable also of being absorbed by unbroken mucous membrane. Most of the recorded cases have occurred in men of good constitution and in the prime of life. The four varieties of this disease which occur in the horse have been observed in man—viz., (1) Acute Glanders, (2) Chronic Glanders, (3) Acute Farcy, (4) Chronic Farcy.

Acute Glanders is the commonest form. The period of inoculation ranges, in the majority of cases, from three days to a week. If there is a distinct wound or abrasion through which the poison has been absorbed, the parts around the broken surface become red, tense, and painful, often before the appearance of any of the constitutional symptoms, such as a general feeling of illness, great depression of the spirits, headache, rigors, increased rapidity of the pulse, and pain in the joints. A characteristic pustular eruption, often accompanied by bullæ or blebs, appears on the face and limbs; and abscesses frequently occur on the face and about the principal joints. A yellow, purulent, fetid discharge, often mixed with blood, exudes from the nasal mucous membrane, which is invariably the seat of a pustular eruption, or of ulcerations. The prostration observable from the beginning increases during the disease. The pulse becomes weak and frequent, the breathing difficult, the voice feeble, and the bowels very relaxed, the stools being extremely fetid. Delirium now sets in, which is followed by coma and death. Death usually occurs about the end of the second week, but the duration of the disease has been known to vary from 3 to 59 days.—*Chronic Glanders* is so rare an affection in man that it hardly requires notice. The course of the disease usually extends over

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several months; and only one case of recovery is reported.—*Acute Farcy* seems to differ essentially from acute glanders only in the fact of there being no affection in the mucous membrane of the nostrils. The cutaneous eruption may or may not be present; in most cases, it is present, and the disease then follows exactly the same course as glanders. When there is no eruption, there is merely an inflammation of the lymphatic vessels and glands, or *Adenitis* and *Angeioleucitis* (q.v.), accompanied with the formation of soft subcutaneous tumors at various parts. This form of the disease often terminates favorably, or may merge into *Chronic Farcy*, which is characterized by the formation of an abscess on the forehead or elsewhere, succeeded by indolent and fluctuating tumors, which follow one another in various parts of the body, open spontaneously, and form very intractable ulcers. The disease usually runs its course in about a year. Of 22 cases recorded by Tardieu, six recovered.

Little need be said regarding treatment, since no remedies have been found to exercise any influence in checking the course of acute glanders. Arsenic, combined with strychnia, has been found useful in chronic glanders in the horse, and is recommended by the brothers Gamgee as worthy of trial in man; and some relief might probably be afforded by the application of weak injections of carbolic acid into the nostrils.

EQUINOX, n. *ē'kwī-nōks* [L. *æquinoctiūm*, the equinox —from *æquus*, equal; *nox*, night; *noctes*, nights]: the time when the sun enters on the equinoctial line—the sun rising higher in the heavens every day at noon till the point (equinoctial) is reached when the days and nights are of equal length all over the world, making what is called the *vernal* or *spring equinox*, about March 21; when the same point is reached in descending, the sun makes what is called the *autumnal equinox*, about Sep. 23. At the vernal equinox, the sun is passing from s. to n., and in the n. hemisphere the days are lengthening; at the autumnal, he is passing from n. to s., and the days are shortening. As the earth moves more rapidly when near the sun, or in winter, the sun's apparent motion is not uniform, and it happens that he takes eight days more to pass from the vernal to the autumnal equinox, than from the latter to the former. The equinoctial points are not stationary. Sometimes they are called the equinoxes, but commonly by equinoxes is meant the time when the sun enters those points. See ECLIPTIC. **E'QUINOC'TIAL**, a. -*nōk'shūl*, pertaining to the equinoxes and the regions under the equinoctial; designating an equal length of day and night; occurring at the time of the equinoxes, as the *equinoctial gales*: N. the celestial equator (see EQUATOR, CELESTIAL), the great circle of the celestial concave which divides the heavens into the n. and s. hemispheres, and which derives its name from the phenomenon that at all places on the earth's surface beneath this circle, the nights are equal all the year round, being of the constant length of 12 hours, the sun setting at 6 P.M. and rising at 6 A.M.; the circle in the heavens which the sun appears to describe when the days

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and nights are of equal length. EQUINOCTIAL POINTS, those in which the equinoctial and the ecliptic intersect (see ECLIPTIC); sometimes called the equinoxes (see EQUINOX). EQUINOCTIAL TIME, time reckoned from the instant when the point of Aries passes the Vernal Equinox (see EQUINOX): this instant is selected as a convenient central point for a uniform reckoning of time by astronomical observers. E'QUINOC'TIALLY, ad. -*lī*.

EQUIP, v. ē-kwīp' [F. équiper, to accouter; Icel. *skipa*, to arrange: AS. *sceapan*, to form: Ger. *schaffen*, to create, to provide]: to fit out; to furnish with whatever is necessary. EQUIP'PING, imp. EQUIPPED', pp. -*kwīpt'*. EQUIP'MENT, n. [F. *équipement*]: all necessary articles or furnishings as for an expedition or voyage. EQUIPAGE, n. ēk'wī-pāj [F. *équipage*]: the carriages, horses, liveried servants, etc., of a gentleman, nobleman, or prince; the furniture and necessaries of an army or ship of war, etc. EQ'UIPAGED, a. -pājd, furnished with an equipage.—*Equipment*, *Equipage*, in *military matters*, names of certain of the necessaries for officers and soldiers, comprising horses, horse-appointments, baggage, saddlery, accouterments, etc. The equipment of a private soldier is often used as a name for the whole of his clothes, arms, and accouterments collectively. The *equipage* of an army is of two kinds: it includes all the furniture of the camp, such as tents and utensils, under the name of *camp-equipage*; while *field-equipage* comprises saddle-horses, baggage-horses, and baggage-wagons.—BUREAU OF EQUIPMENT AND RECRUITING, in the U. S. navy, department for supplying vessels with all articles necessary for a voyage, such as rigging, sails, anchors, etc.; charged also with the enlistment of seamen, and with the recruiting service in general.

EQUIPOISE, n. ēk'wī-poyz [L. *aequus*, equal: F. *poids*, weight]: equality of weight; equilibrium.

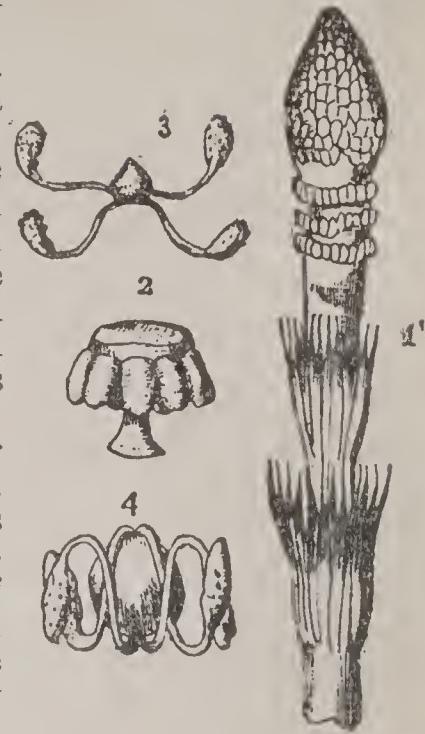
EQUIPOLLENT, a. ēk'wī-pōl'lēnt [L. *aequus*, equal; *pollēt̄em*, being able: F. *équipollent*]: having equal power, strength, or force; equivalent. E'QUIPOL'LENCE, n. -lēns, or E'QUIPOL'ENCY, n. -lēn-sī, ability, power, or force in the same degree.

EQUIPONDERANT, a. ēk'wī-pōn'dér-ānt [L. *aequus*, equal; *pondus*, weight; *pondēris*, of weight]: being of the same weight. E'QUIPON'DERANCE, n. -āns, equality of weight; equipoise.

EQUISETACEÆ, n. plu. ēk'wī-sē-tā'sī-ē, or EQUISE-TUMS, n. plu. ēk'wī-sē'tūms [L. *equisētis*, the plant horse-tail—from *equus*, a horse; *sētā*, a thick stiff hair or bristle]: an extensive order of marsh or boggy cryptogamic plants, represented by the common *horse-tail*. Eq'UISE' TITES, n. plu. -sē'tītz, in *geol.*, fossil plants, resembling the equisetum of our pools and marshes. EQUISETIC, a. ēk'wī-sēt'īk, obtained from the equisetums. EQUISETUM, genus of cryptogamous plants, the structure and affinities of which are not yet well understood, but which many botanists regard as constituting a suborder of ferns, while others prefer to

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make it a distinct order, *Equisetaceæ*. The English name HORSE-TAIL is often given to all the species. They have a leafless, cylindrical, hollow, and jointed stem, each joint terminating in a membranous and toothed sheath, which incloses the base of the one above it. The fructification is at the summit of the stem in spikes, which somewhat resemble trobiles (cones), and are formed of scales bearing spore-cases on their lower surface. The spores are minute, oval, or round, green, and each accompanied with four elastic and hygrometrical threads. These threads are sometimes called *elaters*, but it is by no means certain that they are of the same nature with the spiral filaments so called, which are mixed with the spores of many *Hepaticæ* (q.v.). Each thread terminates in a kind of club. The stems generally have lateral branches, angular, but otherwise similar in structure to the stem, growing in whorls from the joints; sometimes the stem is simple; or fertile stems are simple, and sterile stems are branched. The species of this genus contain a peculiar acid, called *Equisetic Acid*. Astringent and diuretic properties exist in these plants, and they were formerly used in medicine, but are not now regarded as of much value. It has been said that they are very injurious to cattle which eat them, but this lacks confirmation. They abound chiefly in damp soils, and sometimes so much that the plough and harrow, or the grubber, must be employed to extirpate them. Some, however, grow in dry fields and gardens; while others are found chiefly in ditches or the banks of rivers. They exist in almost all parts of the world, and are seldom large, varying from a few inches to a few ft. in height, but a comparatively gigantic species has recently been discovered in tropical America. The rough siliceous stems of some species are used for smoothing and polishing wood, particularly those of *E. hyemale*, which are exported in considerable quantities from Holland, under the name of DUTCH RUSHES. The stems of this species are unbranched, or a little branched only at the base. It is not uncommon in Britain, and is found also, rather sparingly, in N. America. It has been proposed to cultivate it, as it grows well under trees, where few other plants would thrive. The stems of other species, as *E. arvense*, are used for scouring tin and pewter vessels.



Equisetum Telmateia:

- 1, summit of fertile stems with fructification; 2, a scale, with its stalk (lateral view); 3, a spore, with its filaments unrolled; 4, a spore, with its filaments hygrometrically rolled up.

EQUITABLE, a. *équitable*—from L. *aequitatem*, justice—from *aequus*, equal]: fair; just; giving equal

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justice; doing justice; impartial. EQUITABLY, ad. -*bli*. EQUITABLENESS, n. -*bl-nēs*, the quality of being just; state of doing justice. EQUITY, n. -*tī* [F. *équité*, equity—from L. *aequitatem*]: impartial distribution of justice; just regard to right or claim; the supplying of the defects in law by judging according to reason and justice. EQUITABLE DEFENSE at common law, one among certain legal defenses applicable equally to courts of equity and common law. A good example of these is the statute of limitations, whereby claims are outlawed after a lapse of years. But there are particular defenses peculiar to courts of equity.. One of these is ‘founded upon the mere lapse of time and the staleness of the claim in cases where no statute of limitations governs the case’ (Story *Eq. Jur.* § 1520). Other peculiar equitable defenses are, part performance of a parol contract, respecting lands, as against the statute of frauds; account stated; plea of a purchase for a valuable consideration without notice; and want of proper parties to a bill. These defenses were either unknown at common law or were not applied except within rigorously narrow and technical limits. In many of the American states, equitable and legal defenses may be united. EQUITABLE ESTATE, right, title, or interest in property, real or personal, distinct from the *legal* estate. In the eye of the law the *legal* owner has the direct and absolute dominion over the property, but the equitable owner, also styled the ‘beneficiary’ or *cestui que trust*’ is entitled to the avails and income arising therefrom. The rights of owners of equitable estates are enforceable in courts of equity. The relation between the legal owner and the owner of the equitable estate constitutes what is known in law as a ‘trust.’ See USES: TRUST.—EQUITABLE MORTGAGE, mortgage of an equitable interest in an estate. The underlying idea of a mortgage is a transaction intended as a security for the payment of money or the doing of some specified act. Usually it takes the form of a conveyance of property to be held as the security until the condition is fulfilled. Cases arise, however, in which, though there are no conveyances of property, it is necessary, for the purpose of doing justice to imply liens in the nature of mortgages denominated ‘equitable mortgages.’ They are construed from the relations or contracts of the parties. A modern writer (Thomas on Mortgages) thus defines these liens: ‘Equitable mortgages are simply securities by which no legal interest in the property mortgaged passes to the creditor, and thus include those transactions in which property, or the evidences of property, come into the hands of the creditor, upon a written or verbal, express or implied, agreement that such property shall be answerable for the debt, as well as those transactions in which the intention or duty of creating a charge on property is held to arise from an express or implied contract to render that property liable.’ A familiar method in England of creating such liens is by the deposit of title deeds to real estate as a security for the loan of money. In consequence of statutes almost universally prevailing in this country requiring mortgages of real estate to be recorded

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if intended to operate as to third parties, the mode of creating equitable mortgages by deposit of title deeds is not recognized to any great extent. The cases in the United States in which equitable mortgages upon lands have been most frequently sustained, are those in which agreements were made to give a lien but the instruments were defectively or imperfectly executed, or where the parties intending to create a lien have used inapt words for that purpose, or where deeds of real estate absolute on their face, yet contained a reservation in favor of the grantor or some third party. Closely analogous, though perhaps not strictly partaking of the nature of a mortgage, is the lien of a seller of real estate for unpaid purchase money. The remedy of the holder of an equitable mortgage is a suit in equity to enforce the same by a sale of the land. See also MORTGAGE: ESTATE. COURT OF EQUITY, a tribunal, distinct from the common law courts of the country, in which justice is administered by a separate body of rules created and sustained on the strength of precedents or usage; or in which cases are decided according to reason and justice, when they appear to be excepted from the general provisions of the law: see CHANCERY.—SYN. of ‘equitable’: honest; candid; reasonable; right; upright.

EQUITANT, a. *ēk'wī-tānt* [L. *equitan'tōm*, riding—from *equēs*, a horseman]: in bot., applied to a form of vernation, in which the leaves are folded forwards longitudinally on the mid-rib, so that their edges meet, and each embraces the one which is placed next within it; folded leaves when each successively embraces only one-half of the next, are said to be *half-equitant*.

EQUITATION, n. *ēk'wī-tā'shūn* [F. *équitation*, horsemanship—from L. *equitatiōnem*—from *equēs*, a horseman]: the act or art of riding on horseback; horsemanship.

EQUITES: see EQUESTRIAN ORDER.

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EQUITY: see under **EQUITABLE**.

EQUITY, COURTS OF: a department in judicial administration (see **EQUITY, PRINCIPLES OF**); formerly recognized in England by separate courts—which separation was inherited by the British colonies, but is now largely discarded in the United States. The administration of justice in England formerly embraced two great branches, known as common law and equity. Speaking generally, it may be said that equity is partly corrective of the common law, partly supplementary of it; and from this it follows that, in an almost endless variety of matters, the decision of a court would vary according as it was a court of equity or a court of common law; the equity courts giving remedies in cases where the common law—though it may acknowledge a hardship—sees no wrong; and acknowledging and enforcing rights which the common law does not admit. The anomaly of keeping up two sets of courts, acting on different principles, the one to do justice where the traditions of the other prevent it from doing justice, or its rules require it to do injustice, had long been perceived; it had been found, too, that this arrangement was inconvenient as well as anomalous. After attempts at gradual fusion of the conflicting systems by clothing the common-law courts to some extent with the power of resorting to the remedies and admitting the principles employed in the courts of equity, legislative provision was made 1873 for completely revolutionizing the judicial system of England, with a view to a riddance, at one stroke, of its inconvenient and anomalous double system of courts. This was done by the Judicature Act, which was modified 1874–5, and all came into force 1875, Nov. 1 (see **COMMON LAW, COURTS OF**). The Judicature Act merged the existing courts both of equity and common law in one supreme court of judicature, which consisted of a high court of justice in five divisions (now three), all of them courts of first instance. There was an appeal in a few cases to the privy council; and in the other cases to the court of appeal, and then to the house of lords. In the high court there is now a chancery division, before which, at first, the greater part of the equity business requires to be brought; and it is expressly provided that where the rules of the common law conflict with those of equity, every court is to give effect to the latter. The conflict between common law and equity thenceforth ceased; but as the sources from which the law is and will be derived, they will still be referred to.

The origin of a separate equitable jurisdiction in England is found in the early adoption by the courts of common law of certain set forms for the redress of grievances, and their refusal to apply any remedy to cases which did not fall within those limits. Suitors finding that in numerous cases redress was not to be obtained in the ordinary legal tribunals, had recourse to the king as the fountain of justice, who, sitting in council, heard the complaints upon their merits without reference to the technicalities of law. As early as the reign of Edward I., the practice began to be adopted of delegating to the chancellor (q.v.) the petitions referred to the king. In this reign, an attempt was made to devise a method whereby the common-law courts should be made

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the sole tribunal for the redress of grievances. By the statute of Westminster the second (13 Edw. I, c. 24), it was enacted that whenever a case occurred requiring a new writ, the chancery (in which all suits took their rise) should frame a new writ to suit the case. This statute was never acted upon to the purpose intended; but in the reign of Edward III. its provisions were made use of by John Waltham, then chancellor, to introduce the writ of *Subpæna* (q. v.) returnable to chancery only, whereby the lord chancellor's court was made the forum of a large class of causes. 'From this time,' says Mr. Spence (*Chancery Jurisdiction*, i. 338), 'suits by petition or bill without any preliminary writ became a common course of procedure before the chancellor, as it had been in the council. On the petition or bill being presented, if the case called for extraordinary interference, a writ was issued by the command of the chancellor, but in the name of the king, by which the party complained against was summoned to appear before the court of chancery, to answer the complaint and abide by the order of the court.' Thus was introduced into chancery the practice of examining upon oath the party in the cause, a practice unknown at that time to common law. The cases heard in the chancery courts were decided upon the principles of *honesty, equity, and conscience*. The next step which tended to widen the equitable jurisdiction of the chancery courts, was the exclusion of the Roman law from the courts of common law. This was effected by a prohibition of the judges in the reign of Richard II. One result of this prohibition was to exclude altogether from the common-law courts the question of trusts. The court of chancery at once proceeded to give a remedy in this class of cases, which has ever since formed the most important branch of the equitable jurisdiction of that court. The equitable jurisdiction of the court of chancery in matters of fraud is to be traced to the abolition of the star chamber (q. v.) in the reign of Charles I. Thus sprung up in England jurisdiction of the court of chancery as a court of equity. It is not, however, to be supposed that the system administered in courts of equity is an arbitrary one at the pleasure of the presiding judge. Such probably was the case on the first introduction of the equity jurisdiction; but as time passed, the decisions of previous judges formed precedents for their successors, and the precepts of the Roman law were much imitated as a code for the regulation of the courts. Now, all the judges acknowledge the authority of decided cases—of the practice of the court—quite as fully as did courts of common law; and though new cases perhaps occur more frequently than they did in the courts of common law, they are dealt with as they were in courts of common law, by the application to them, as far as possible, of accepted principles derived from the decisions of the court of chancery, or the principles of the Roman law. See CHANCELLOR: CHANCERY, COURT OF.

The jurisdiction of equity courts was divided under three principal heads—exclusive, concurrent, and assistant. The first consists almost entirely of the administration of trusts; the second comprises questions of fraud, of account, and

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also, it is said (Smith's *Principles of Equity*, 217), of specific performance of agreements. This matter appears, however, to fall more naturally under the assistant jurisdiction. In order to appreciate the domain of the equity courts, it must be borne in mind that common law confines its remedy usually to the awarding of damages, and to the pronouncing a judgment absolutely in favor of either plaintiff or defendant; equity, on the other hand, goes into all the merits of the case, and will deliver a modified judgment where circumstances demand it. The judges of the supreme court now all administer equity as well as law in the same manner as the court of session in Scotland had been accustomed to do from the beginning. In whichever division of the high court an action commences, that division must dispose of all the issues raised, and pursue these to final judgment. It is true one of the divisions is still called the chancery division, and actions which used to be begun in equity courts now usually begin there still. But there is a power in such division to send an issue of fact to be decided on circuit, and after trial the division resumes its jurisdiction and works it out. The chancery division consists of judges chosen from the bar generally; and the court of appeal, which sits in two divisions, consists also of judges some versed in chancery business, and some versed in common law business. The lord chancellor since 1875 has confined his sittings to the house of lords, and occasionally to the court of appeal and to the privy council, of all of which courts he is *ex officio* a member.

Courts of Equity in the United States.—The principles according to which substantive equity is administered are the same in England and the United States. In fact, they must necessarily be the same the world over. In respect, however, to the mode of procedure, differences exist in the various American courts, though the practice formerly prevailing in the high court of chancery in England may be regarded as the basis of all the different systems. Courts of chancery, in which equity was administered as a separate system of jurisprudence, were early established in N. Y., N. Jer., Md., Del., S. Car., and Mich. The abolition of the court of chancery as a separate tribunal in N. Y., 1848, opened the way to a great reform, whereby equity and common law were to be administered in the same courts and the practice in each consolidated as far as possible. Passing from N. Y., the reformed procedure was adopted in O., Ky., Ind., Wis., Io., Minn., Miss., Kan., Neb., Nev., Cal., Or., N. Car., S. Car., Conn., Wash. Terr., Mont., Ida., Dak., Wyo., and Arizona. In most of the jurisdictions which have not adopted the plan of consolidation, namely the Federal courts, and Ark., Fla., Ga., Ill., Me., Md., Mass., Mich., N. Ham., Penn., R. I., Tex., Vt., Va., and W. Va., the two systems are kept distinct, but relief is administered by the same tribunal, sitting in one case as a court of equity and in another as a court of law. In some of the states the policy of strictly separating the two kinds of courts is retained, namely, Ala., Del., Miss., N. Jer., and Tennessee. The consolidation of the practice in equitable and common-law

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cases, which starting in New York, will gradually make its way all over the country, is one of the most important legal reforms of modern times. By it immense delay, vexation, expense, and uncertainty are spared the litigant. The most important subject usually brought before courts of equity in the United States, are applications for relief connected with trusts, fraud, mistake, injunctions, mortgages, accident, and account.

EQUITY, PRINCIPLES OF: in their widest sense, the principles of eternal justice, of which all human laws are but adaptations. ‘Equity’, says Lord Stair (i. l. s. 17), ‘is the body of the law, and the statutes of men are but as the ornaments and vestiture thereof.’ In this sense, equity coincides with the Roman precepts of law—*honesté vivere, alterum non laedere, suum cuique tribuere*—(*Inst.* i. l. s. 3), and with the principles of justice as laid down by the inspired writer—‘to do justly, to love mercy, and to walk humbly with thy God’ (*Micah*, vi. 8). As the object of human law is to give expression to these principles, equity is thus the basis of law. But it is impossible, in the nature of things, that any code of laws should provide a remedy suited to every particular case; it has, therefore, been found necessary in every civilized nation, to establish some form of authority which should control the rigor and remedy the deficiency of positive law. Thus, it is the function of the law to lay down a code of rules whereby the rights of property and the transactions of commerce shall be regulated; but by the diversities of life it happens that various circumstances will occur to cause these fixed rules to operate harshly or unjustly in particular cases. A party may complain that a contract duly entered into with all legal formalities has been obtained by fraud; the owner of an estate is incapable from infancy or lunacy of managing his affairs; a person ostensibly the owner of large property is found to be placed in possession in trust only for the benefit of others. In these and many other cases, the party who, in compliance with every rule of the law, is in possession, is not in fact the person who should in justice exercise the right. Here equity steps in. While, then, all law may be said to be equitable, inasmuch as it is the purpose of law to dispense justice, yet, in the technical sense, the term equity is confined to those cases not specially provided for by positive law. But, on the other hand, experience has shown that it would be most inconvenient, and subversive of order, if equity should arbitrarily interpose to remedy every apparent grievance, and therefore it is that the operation of equity is checked within certain limits. ‘There are many cases against natural justice which are left wholly to the conscience of the party, and are without any redress, equitable or legal; and so far from a court of equity supplying universally the defects of positive legislation, it is governed by the same rules of interpretation as a court of common law, and is often compelled to stop where common law stops. It is the duty of every court of justice, whether of law or of equity, to consult the intention of the legislature.’—Story, *Principles of Equity*,

EQUITY OF REDEMPTION—EQUIVALENT.

s. 14. Hence arises the maxim, that ‘equity follows the law.’ The principles of equity, therefore, as understood in modern times, may be said to be those principles of natural justice which are permitted to modify the rigor of positive law. In applying these principles to practice, the equitable jurisdiction has been intrusted by almost all nations to the same courts in which the positive law was administered: see CHANCERY, COURT OF: EQUITY, COURTS OF: COMMON LAW: ETC. In the infancy of states, the boundaries of law and equity, and the functions of the equity judge, were not so clearly defined as in the present day. By the Roman law, a power, called the *jus honorarium* or *nobile officium*, was reposed in the pretor of controlling on equitable grounds the decisions of the ordinary tribunals. This function of the pretor commenced in the earliest times under the kings of Rome, and continued to attach to the office through all the changes which distracted the nation. Each pretor, on entering upon his office, published an edict declaring the principles by which he would be guided in discharging his duty as an equitable magistrate. The principles so declared were binding on the pretor during his year of office, but not on his successor. There can, however, be little doubt that in process of time a system of equity was gradually evolved; and ultimately, in the reign of the Emperor Hadrian, the edicts of the pretors were collected by a civilian named Julianus, and embodied in a single code called the Perpetual Edict: see EDICT. According to the practice of modern nations, the courts of law are accustomed to exercise a certain equitable jurisdiction whereby, within prescribed limits, the rules of law may be modified. In Scotland the equitable power of the court of session is called the *Nobile Officium* (q. v.).

EQUITY OF REDEMPTION: interest which a mortgager has in an estate which he has mortgaged. In Britain, equity of redemption may be devised, granted, or entailed, and the course of descent to an equity of redemption is governed by the same laws as the descent to the land would have been. Formerly, the equitable interest of a mortgager could not be recognized in a court of law, but by 7 Geo. II. c. 20, it is provided that where no suit is pending in a court of equity, either for foreclosure or redemption, but the mortgagee attempts to obtain possession by bringing an action of ejectment, in such a case, the court may restore his estate to the mortgager, on his payment of the principal and interest due on such mortgage.—In this country, the laws on this matter vary in different states.

EQUIVALENT, a. *é-kwiv'ā-lēnt* [F. *équivalent*—from L. *equivalēn'tem*—from L. *æquus*, equal; *vālens*, being worth, or of the value of]: equal in value or worth; equal in power, force, or effect; of the same import or meaning: N. that which is equal in value, weight, etc., to something else; offset; compensation; in *geol.*, strata or a series of strata that have been formed contemporaneously in distant regions, or which are characterized by similar suites of fossils. **EQUIVALENTLY**, ad. -*lē*. **EQUIVALENCE**, n. *-lēns*, equal value or

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worth; also EQUIV'ALENCY, n. -*sī*. EQUIVALENTS, in *chem.*, the quantities by weight of elementary substances which combine with one another to form definite compounds: see ATOMIC WEIGHTS.

EQUIVOCAL, a. ē-*kvīvō-kāl* [L. *aequus*, equal; *vōcālis*, sounding, speaking—from *vox*, a voice: It. *equivocale*]: of doubtful signification; uncertain; that may be understood in different senses; doubtful. EQUIV'OCALLY, ad. -*lī*. EQUIV'OCALNESS, n. a double meaning; ambiguity. EQUIV'OCATE, v. -*kāt*, to use words of doubtful meaning; to quibble; to prevaricate; to evade. EQUIV'OCATING, imp.: ADJ. using ambiguous words or phrases. EQUIV'OCATED, pp. EQUIV'OCATOR, n. -*tēr*, one who. EQUIV'OCATION, n. -*kāshūn*, the use of words that have a double or doubtful meaning—usually in bad sense; prevarication. EQUIV'OCATORY, a. -*tēr-ī*, containing or savoring of an equivocation. ÉQUIVOQUE, n. ā-*kī-vōk'* or ē-*kwī-vōk'* [F.]: an expression in which a word has at once different meanings; a quibble.—SYN. of ‘equivocal’: ambiguous; indeterminate; dubious; prevaricating; evading; shuffling; quibbling.

ER: Eng. affix corresponding to the French *-eur* and Latin *-or*, and used for forming nouns of agency. It is used for persons or things of any gender, but was originally masculine, the corresponding feminine forms being *-ster*, *-stre*, which also has lost its feminine force. As a rule words in *-or* are of Latin origin, those in *-er* of English origin, but there is a tendency to drop the former termination in favor of the latter. *Er* is an affix also denoting an inhabitant, native of, or dweller in a place. *Er* is also the sign of the comparative degree of adjectives in English; cognate with L. *-or*, and Gr. *-eros*. The *r* represents an original *s*. *Er* is an affix also used with verbs to give them a diminutive or frequentative force; as, pat, patter; spit, sputter.

ER, *ér*: in *her.*, frequent abbreviation of the word ermine.

ERA, or ÆRA, n. ē-*rā* [L. *æra*, the particulars of an account, period of service, an era: F. *ère*; Sp. and It. *era*, age, era: akin to AS. *gear*, a year]: a fixed point of time from which a nation or people reckon their years, as Christian era; a succession of years from a fixed point, as ‘we live in the Christian era’ (see CHRONOLOGY); in geol., the commencement of a new system or formation, or the entire duration of that system or formation. Note.—An epoch is a point of time fixed by historians, or a certain memorable period of years,—thus the capture of Constantinople is an epoch in the history of Mahometanism, while the flight of Mahomet is its era. The Crusades and the Reformation are epochs in the history of Christianity, but the birth of Christ begins its era. To indicate a starting-point of a series of events, we say, however, ‘the era of the Reformation, of geology,’ etc. Age denotes a certain indefinite but limited time embraced by joint human lives, and may even extend to centuries, as iron age: generation, a period embraced by an average human life.—SYN. of ‘era’: age; period; date; epoch; time.

ERADICATE—ERASE.

ERADICATE, v. ē *rād'i-kāt* [L. *eradicātus*, plucked up by the roots—from *e*, out of; *rādix*, a root: It. *eradicare*]: to pull up by the roots; to destroy thoroughly; to extirpate. **ERADICATING**, imp. **ERADICATED**, pp. **ERADICATOR**, n. -*tér*, one who. **ERADICABLE**, a. -*kā-bl*, that can be rooted up or completely destroyed. **ERADICATION**, n. -*kā-shūn*, complete destruction; the state of being plucked up by the roots. **ERADICATIVE**, a. -*tīv*, that cures or destroys thoroughly.—SYN. of ‘eradicate’: to exterminate; root out; destroy.

ERAGROSTRIS, n. ēr *a-grōs'trīs* [Gr. *erōs*, love; mod. L. *agrostris*, with reference to the dancing spikelets of the flower]: in bot., genus of grasses, tribe *Festuceæ*, family *Bromidæ*. Stendel enumerates 243 species. Some are cultivated as ornamental grasses.

ERANTHEMEÆ, n. ēr-ān-thē-mē'ē: in bot., tribe of *Acanthaceæ*. **ERAN'THEMUM**, n. -*mūm* [Gr. *eros*; *anthemon*, a flower]: in bot., genus of *Acanthaceæ*, typical of the tribe *Eranthemeæ*. Corolla salver-shaped, stamens four, only two of them fertile. About 20 species are cultivated in greenhouses.

ERANTHIS, n. ēr-ān'thīs [Gr. *eros*, love; *anthos*, blossom, flower]: in bot., winter-aconite. A genus of plants, order *Ranunculacæ*. Sepals five to eight, narrow, petaloid, deciduous; petals small, clawed, and two-lipped; stamens many; carpels five to six, stipitate; follicles many-seeded.

ÉRARD, ā-rār', SEBASTIEN: 1752, Apr. 5—1831, Aug. 5; b. Strasburg, France: inventor and manufacturer. He was the son of a cabinet-maker, learned the manufacture of harpsichords in Paris, and under the patronage of the Duchess de Villeroi constructed the first piano-forte made in France, 1780. The popularity of the instrument induced him to establish a factory in Paris, in connection with his brother, Jean Baptiste E.; and within a short time the E. brothers became known as the best piano-forte manufacturers in Europe. During the French revolution the brothers carried on the manufacture of pianos and harps in London, but Sébastien returned to Paris 1796. He invented the grand piano with single and double action, and the famous double-action harp, made many other improvements in both instruments, and designed and built the great organ for the royal chapel of the Tuilleries.

ERASE, v. ē-*rās'* [L. *erāsūs*, scraped out—from *e*, out of; *rāsus*, scraped: F. *raser*, to shave]: to scrape or rub out; to obliterate; to expunge; to blot out or deface. **ERA'SING**, imp. **ERASED'**, pp. -*rāst'*. **ERA'SER**, n. one who, or that which. **ERA'SABLE**, a. -*sū-bl*, that can be scraped out or obliterated. **ERASE'MENT**, n. -*měnt*, a rubbing out; obliteration. **ERA'SURE**, n. -*zhūr*, the act of scratching out; the place where a letter or word has been rubbed out. **ERASED AND ERADICATED**, in *heraldry*, applied to an object plucked off or torn out, showing a ragged edge; opposed to *coupé* or *coupy*, cut, which shows a smooth edge—SYN. of ‘erase’: to efface; cancel; scrape out; blot out; destroy.

ERASISTRATUS--ERASMUS.

ERASISTRATUS, *ēr-a-sīs'tra-tūs*: one of the most famous physicians and anatomists of ancient times: lived B.C. 3d c.: supposed to have been born at Iulis, in the island of Ceos. He resided some time at the court of Seleucus Nicator, King of Syria, and while there acquired great renown by discovering and curing the disease of the king's eldest son, who was pining for the love of the young and beautiful Stratonice, whom his father in his old age had married. Afterward, E. lived at Alexandria, where, giving up practice, he applied himself with great energy and success to his anatomical studies. The date of his death (probably in Asia Minor) is not known. He founded a school of medicine, wrote several works on anatomy—in which branch he was most celebrated—on practical medicine, and pharmacy. He believed that the heart was the origin both of the veins and of the arteries, and, had it not been his conviction that the arteries contained *air* instead of *blood*, little doubt is entertained but that he would have anticipated Harvey in the discovery of the circulation of the blood. Of his numerous writings only some obscure fragments and titles have been preserved. Compare Hieronymus, *Erasistrati et Erasistrateorum Historia* (Jena 1790).

ERASMUS, *ē-rāz'mūs*, DESIDERIUS: one of the most vigorous promoters of the Reformation: 1467, Oct. 28—1536, July 12; b. Rotterdam; illegitimate son of a Dutchman named Gheraerd, or Garrit, by the daughter of a physician. In accordance with the fashion among scholars of his time, he changed the name Gheraerd into its Latin and Greek equivalents Desiderius Erasmus (more correctly, Erasmus)—meaning desired, loved. Till his ninth year, E. was a chorister in the cathedral at Utrecht. He was then sent to school at Deventer, where his talents began to display themselves in so brilliant a manner, that it was even then predicted that he would be the most learned man of his time. After the death of his parents, whom he lost at the age of 14, his guardians determined on bringing him up to a religious life, and—with the intention, it is said, of sharing his small patrimony among themselves—in his 17th year, placed him in the monastery of Emaus, near Gouda. From this constrained life, however, he was released by the Bishop of Cambrey. After having taken priest's orders 1492, he went to Paris, to perfect himself in theology and the humane sciences. Here he supported himself precariously by giving private lectures, and in 1497 accompanied some Englishmen, who had been his pupils, to England, where he was well received by the king. He soon returned to Paris, and in 1506 visited Italy. At Turin he took the degree of D.D. Shortly afterward he applied to the pope for a dispensation from his monastic vows, which was granted. During the course of his journey, he visited Venice, Parma, Rome, and other cities, with his pupil, Alexander Stuart, natural son of James IV. of Scotland. At Rome, the most brilliant prospects were held out to him. Cardinal Grimani, famous lover of learning in that day, offered, out of his admiration for E., to make him 'partaker of his house and fortunes.' Other eminent men vied with Grimani in showing respect

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to the young scholar, among whom were John de' Medici, afterward Leo X., Cardinal Raphael of St. George, and Giles of Viterbo, general of the Augustines. The pope (Julius II.) also offered him a place among his penitentiaries, an office of considerable consequence, and it would appear, a 'step to the highest preferments in that court.' E., who had always an eye to the main chance, regretted, at a later period of his life, that he had not accepted the offers held out to him in Rome, but meanwhile, having pledged himself to return to England, where also he had many friends, he set out for that country 1509, after the accession of Henry VIII. In several of the cities through which he passed he met friends and patrons, who wished him to settle among them, but as Henry was a correspondent of his, E. was induced to cherish the highest hopes of personal favor from that monarch, and could not be prevailed on to make long stay. He had no sooner arrived in England than he found out his mistake. At first, he lodged with Sir Thomas More, and during his stay with him composed his *Encomium Moriae*, or Praise of Folly, the purpose of which is to expose all kinds of fools, but especially those who flourished in the church, not sparing the pope himself. For a short time he filled the office of prof. of Greek at Oxford, but on the whole was very scantily supplied with the means of subsistence. In 1514, he returned disappointed to the continent and resided chiefly at Basel, where he died. E.'s extensive and profound learning was equalled by his refined taste and brilliant wit. A natural love of independence and quiet made him prefer a life of learned leisure and retirement to one of greater publicity; nevertheless, the readiness with which he assumed the character of an adroit man of the world, brought upon him the hostility of many of the nobler spirits of his time. He was no hero, and he knew it. He frankly confesses that 'he had no inclination to die for the sake of the truth.' Luther, in whom the soul and courage of the Apostle Paul seemed to be revived, overwhelmed him with reproaches for his cowardice in regard to the Reformation. But we must not forget that E. by his mental constitution was averse to enthusiasm. He was a scholar and a critic, not a preacher or iconoclast, and he was at least honest enough to abstain from denouncing the opinions of Luther, though he disapproved strongly of his violent language. Besides, there was a tincture of rationalism in the great Dutchman, which probably helped to chill his love of mere *Lutheranism*. But his services in the cause of science were great and lasting, and his writings are still esteemed for the importance of their subjects, and their classical style. Besides editing several of the ancient authors, and various philological and theological writings, he prepared the earliest edition of the Greek Testament, which appeared at Basel 1516. This is reckoned by some his greatest work. Michaelis says that perhaps there never existed an abler editor of the New Testament, and that E. possessed in the highest degree natural abilities, profound learning, a readiness in detecting errors, with every qualification that is requisite to critical sagacity. His best-known work, however, is his

ERASTIAN—ERASTUS.

Colloquia, a master-piece. Of all his writings this has had the greatest influence. The first edition appeared 1522, but did not please E., who issued a second the same year. A third appeared 1524. This book, which was meant, according to Erasmus, only to make youths better Latinists and better men, was condemned by the Sorbonne, prohibited in France, and burned in Spain. No one who takes up the book will wonder at its condemnation. It contains the most virulent and satirical onslaughts on monks, cloister-life, festivals, pilgrimages, etc., but is disfigured by lewd and unchaste passages wholly inexcusable. The work has been translated into almost all modern languages. His *Encomium Morie*, or Praise of Folly, already mentioned, was published in the original, with a German translation, and illustrations by Holbein, by W. G. Becker (Basel 1780). E. himself superintended an edition of his works published by Frobenius in Basel. The most complete edition is that of Leclerc (10 vols. Leyden 1603–06). The life of E. has been written in French by Burigny (2 vols. Paris 1758), in German by Müller (Hamburg 1828), and in English by Knight (Cambridge 1726) and Drummond (2 vols. 1873).

ERASTIAN, a. ē-răs'ti-ăn: pertaining to *Erastus* or his doctrines. ERAS'TIANS, n. plu., those professing the doctrines of *Erastus*, a German divine and physician of the 16th century, who taught that the church ought to be wholly dependent on the state for its government and discipline. ERAS'TIANISM, n. -izm, the principles of the Erastians.

ERASTUS, ē-răs'tüs, THOMAS: 1524, Sep. 7—1583, Dec. 31; b. Baden, Switzerland: physician and theologian. His real name was *Lieber*, which, according to the fashion of his times, he translated into Greek. In 1540, he went to the Univ. of Basel, where he studied divinity, philosophy, and literature. He subsequently visited Italy, where he betook himself to medicine, and obtained the degree M.D. from the Univ. of Bologna. After nine years, he returned to his own country, and lived at the court of the princes of Henneberg, where he acquired great reputation as a medical practitioner. The elector palatine, Frederick III., invited him to his court, and appointed him first physician and counselor of state. He also conferred on him the chair of physic in the Univ. of Heidelberg. In 1581, he was selected to fill a similar office at Basel, where he died, after establishing a liberal foundation for the provision and education of poor students in medicine, long called the *Erastian foundation*. Among E.'s medical works are *Disputationes de Medicina Nova Philippi Paracelsi* (Basel 1572–3), *Theses de Contagio* (Heidelberg 1574), and *De Occult. Pharmaco. Potestatibus* (Heidelberg 1574). As a physician, E. is creditably characterized by his distrust of abstract and *a priori* theorizing, and his conviction that experimental investigation is the only road to knowledge. But his fame now rests chiefly on what he wrote in ecclesiastical controversy. In his book *De Cena Domini*, he contended for the figurative interpretation of the passage, ‘This is my body,’ etc., and supported this view at the conference held at Maul-

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bron between the divines of the Palatinate and those of Wittenberg. But his great work is his *Explicatio Quæstionis Gravissimæ de Excommunicatione*. Although this work was not published till some years after his death, E. had published the same opinions in the form of theses, directed against Gaspar Olevianus, a refugee from Treves, and various other persons, who were anxious to confer on ecclesiastical tribunals the power of punishing vices and misdemeanors. E. denied the right of the church to excommunicate, exclude, absolve, censure—in short, to exercise discipline. Denying ‘the power of the keys,’ he compared a pastor to a prof. of any science, who can merely instruct his students; he held that the ordinances of the gospel should be open and free to all, and that penalties being both in their nature and effect *civil* and not *spiritual*, ought to be inflicted only by the civil magistrate. E. formed no *sect*, neither did he wish to do so. His desire was exactly contrary—viz., to preserve an external harmony at the expense even of the purity of the visible church. He would have let the wheat and tares not only grow together, but also remain entirely undistinguished in the church until the end of the world. Many eminent men, especially in the Church of England, have had similar opinions both before and after E., such as Cranmer, Redmyn, Cox, Whitgift, Lightfoot, Selden, etc. His views had some eloquent adherents in the Westminster Assembly 1643–49; but after a long discussion were rejected with but one dissentient vote. The term Erastian has long been a favorite epithet of reproach among the more rigid Presbyterians in Scotland, but has not been employed with any precision. All persons who deny the power of an established church to alter her own laws without the consent of the state—as, for example, the law of patronage—are generally accused of *Erastianism*, though the principles of E. have literally nothing to do with such a question. An English translation of the *Explicatio* was published 1669, re-edited by Dr. Robert Lee 1845.

ERA'SURE, or RA'ZURE: scraping or shaving out of words in a deed or other formal writing. Except in the case of a will, the presumption, in the absence of rebutting evidence, is that the erasure was made at or before execution. *Doe ex dem Tatham v. Gattamore*, 17 L. T. Rep. 74. If an alteration or erasure has been made in any instrument subsequent to its execution, that fact ought to be mentioned (in the Abstract, or epitome of the evidences of ownership), together with the circumstances under which it is done, and more particularly so as a fraudulent alteration by either of those means, if made by the person himself taking under it, would vitiate his interest altogether. It was formerly considered in England that an alteration, erasure, or interlineation (q.v.), would void the whole instrument, even in those cases where it was made by a stranger; but the law in both England and the United States is now otherwise, as it is clearly settled that no alteration made by a stranger will prevent the contents of an instrument from retaining its original effect and operation, where it can be plainly shown what that effect and operation actually was. To accomplish

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this, the mutilated instrument may be given in evidence as far as its contents appear; and intrinsic evidence will be admitted to show what portions have been altered or erased, also the words contained in such altered or erased parts; but if, for want of such evidence, or any deficiency or uncertainty arising out of it, the original contents of the instrument cannot be ascertained, then the old rule would become applicable, or, more correctly speaking, the mutilated instrument would become void for uncertainty.—Hughes' *Practice of Conveyancing*, I. 124, 125. If a will contains any alterations or erasure, the attention of the witnesses ought to be directed to the particular parts in which each alteration occurs, and they ought to place their initials in the margin opposite, before the will is executed, and to notice this having been done by a memorandum, added to the attestation clause at the end of the will (*Ib.* p. 945). In Scotland, the rule as to erasure is somewhat stricter; see Menzies's *Lectures on Conveyancing*, p. 124. The Roman rule was, that the alterations should be made by the party himself, and a formal clause was introduced into their deeds to this effect, ‘*Lituras, inductiones, superinductiones, ipse feci.*’ As a general rule, alterations with the pen are in all cases to be preferred to erasure; and suspicion will be most effectually removed by not obliterating the words altered so completely as to conceal the nature of the correction. ‘The worst kind of deletion,’ says Lord Stair, ‘is when the words deleted cannot be read (but if they are scored that they can be read, it will appear whether they be *de substantialibus*), for if they cannot be read, they will be esteemed to be such, unless the contrary appear by what precedes and follows, or that there be a marginal note, bearing the deletion, from such a word to such a word, to be of consent.’

ERATO, n. ēr'ā-tō [Gr. *Eriatō*, one of the Muses—from *erō*, I love]: the Muse who presided over lyric, and especially amatory, poetry. **ERATIVE**, a. ēr'ā-tīv, pertaining to the Muse who presided over amatory poetry.

ERATOSTHENES, ēr-a-tōs thē-nēz |: eminent Greek writer, called, on account of his varied erudition, the *Philologist*: b.c. 276—b.c. 186; b. Cyrene. Among his teachers were Lysanias the grammarian, and Callimachus the poet. By Ptolemy Euergetes, he was called to Alexandria to superintend his great library. Here he died of voluntary starvation, at the age of 80, having become blind, and wearied of life. E. holds eminent rank among ancient astronomers. He measured the obliquity of the ecliptic, and the result at which he arrived—viz., that it was $23^{\circ} 51' 20''$ —must be reckoned a very fair observation, considering the age in which he lived. Hipparchus used it, and so did the celebrated astronomer Ptolemy. An astronomical work which goes under the name of E., but which is certainly not his, is extant, called *Katasterismoi*; it contains an account of the constellations, their fabulous history, and the stars in them. It is believed, however, that E. did draw up a catalogue of the fixed stars, amounting to 675: but it is lost. A letter to Ptolemy, king of

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Egypt, on the duplication of the cube, is the only complete writing of his that we possess. E.'s greatest claim to distinction, however, is as a geometer. In his attempt to measure the magnitude of the earth, he introduced the method used at the present day, and found the circumference of the earth to be 252,000 stadia; which, according to Pliny, is 31,500 Roman miles. But as it is not known *what* stadium E. used, it is possible that he came nearer the actual circumference than the above figures indicate. His work on geography must have been of great value in his times: it was the first truly scientific treatise on the subject. E. wrought into an organic whole the scattered information regarding places and countries related in the books of travels, etc., in the Alexandrian library. He wrote also on moral philosophy, history, grammar, etc. His work on the *Old Attic Comedy* appears, from the remains which we possess, to have been a learned and very judicious performance. Such fragments of E.'s writings as are extant have been collected by Bernhardy in his *Eratosthenica* (Berlin 1822).

ERBIUM, n. *er'bī-ūm* (symbol E): an element, found with other rare elements, such as ytterbium, scandium, etc., in a few minerals, such as the gadolinite or ytterbite of Sweden. Yttrium, containing E., has been separated as a blackish powder, but E. has never been isolated. The oxide and salts of E. are rose-red.

ERCILLA Y ZUÑIGA, *ér-thēl'yá é thón-yē'gá*, ALONSO: Spanish poet: b. Madrid, 1533, Aug. 7; date of death unknown. He was the third son of a Spanish jurist, and at an early period became page to the Infanta Don Philip, son of Charles V., accompanying him on his journey through the Netherlands, and some parts of Germany and Italy, and in 1554, to England, on the occasion of the celebration of Philip's nuptials with Queen Mary. Shortly afterward E. went with the army dispatched to America to quell the insurrection of the Auracanians on the coast of Chili. The difficulties with which the Spaniards had to contend, the heroism displayed by the natives in the unequal contest, and the multitude of gallant achievements by which this war was distinguished, suggested to E. the idea of making it the subject of an epic poem. He began his poem on the spot, about 1558, occasionally committing his verses, in the absence of paper, to pieces of leather. An unfounded suspicion of his having plotted an insurrection involved him in a painful trial, and he had actually ascended the scaffold before his innocence was proved. Deeply wounded, the brave soldier and poet turned to Spain, but Philip treating him with great coldness and neglect, E. made a tour through France, Italy, Germany, Bohemia, and Hungary. For some time he held the office of chamberlain to the emperor Rudolf II., but 1580 returned to Madrid, where the latter years of his life were spent in obscurity and poverty. He died at Madrid. His historic epos, written in the octo-syllabic measure, and entitled *Araucana*, is, with the exception of a few episodes,

ERCINITE—ERCKMANN—CHATRIAN.

a faithful description of actual events. Cervantes, in his *Don Quixote*, compares it with the best Italian epics, and it has undoubtedly not a little of the epic style and spirit. Of its three parts, the first is the freshest in character, having been completed before the author's return to Europe, where it was published separately (Madrid 1569). In Spain, and other countries, many reprints of the poem appeared, notably in 1776, 1828, 1851. A German translation was published by Winterling (1831), and a complete French one by Nicolas (1870). See Royer's *Étude sur l'Araucana de E.* (1880).

ERCINITE, n. *ér'sin-it* [from *Sylva Hercynia*, Roman name for the Harz Mountains, in which it was found at Andreasberg]: in *min.*, the same as HARMOTOME (q.v.).

ERCKMANN—CHATRIAN, *érk'mán, shá-tré-öng'* (EMILE ERCKMANN and ALEXANDRE CHATRIAN): two French men of letters. Erckmann was born Phalsbourg, 1822, May 20. Chatrian was b. in the village of Soldenthal 1826, and died 1890, Sep. 4. Both were born in what was then the French dept. of Meurthe, now reunited to Germany as part of the imperial territory of Alsace-Lorraine. E., the son of a bookseller, went through a rather irregular course of study at the college of his native town, went to Paris 1842 to study law, which he broke off several times, and only passed his third examination 1857, and finally abandoned the study in the following year. During the interval, he had set himself to make a name in literature, in co-operation with M. Chatrian. The latter, belonging to an old family of glass-makers in Meurthe, ruined by reverses in trade, was acting as tutor at the college of Phalsbourg, when, 1847, he was introduced to M. Erckmann. From that time the two friends employed their pens in the same works till a temporary break in collaboration 1889; and it was only about 1863 that the authors informed their readers that the numerous works of fiction, which had obtained a widespread popularity, and were supposed by the general public to be the work of a single writer, were the fruits of their friendly collaboration. Their early works attracted comparatively little notice; and it is said that their first work was rejected by all the newspapers of Paris, and by many provincial journals. In 1848 they published several feuilletons in the *Démocrate du Rhin*, which had just been started: *Le Sacrifice d'Abraham*, *Le Bourgmestre en Bouteille*, etc., which they have since published separately. At the same time they wrote a drama, *Le Chasseur des Ruines*, for the Ambigu-Comique, which the theatre accepted, subject to changes, which they refused to make. They produced another drama, *L'Alsace en 1814*, for the theatre of Strasbourg, which was suppressed by the prefect on the second representation. They wrote numerous novels at this time for different journals, some of which were very little noticed, while others remained in MS. for years. Despairing of being able to live by their pens, E. recommenced his law studies, and C. obtained a situation in the office of the Eastern railway. It

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was not till 1859 that *L'ILLUSTRE DOCTEUR MATHÉUS* (1859; 3d ed. 1864), published by the Librairie-Nouvelle, gave a certain éclat to the collective name of Erckmann-Chatrian. *Le Fou Yégo* (1862) is one of a series of novels, the subjects of which are taken from their national history, and gives a picture of the invasion of 1814. *Le Conscrit de 1813* (1864) and *Waterloo* (1865) are fragments of an autobiography, and are supposed to be the recollections of a common soldier, and relate the disastrous campaigns of 1813–14. These may be called the gems of their collection. *Le Joueur de Clarinette* (1863), a simple story of a village musician, and *Les Amoureux de Catherine*, another tale of village life in the same volume, are nearly perfect. *L'Homme du Peuple* appeared 1865, and is less favorably spoken of as a work of art. It pictures the life of the modern French workman. In 1866 appeared *La Maison Forestière* and *La Guerre*; in 1867, *Le Blocus*, which has been translated under the title *The Blockade of Phalsbourg*; a historical romance 1868, *Histoire d'un Paysan*; 1869, *Le Juif Polonais*, a play. In 1889, a serious quarrel occurred between the two authors concerning a division of profits, and for a time they were entirely estranged; but before the death of Chatrian they were reconciled. Afterward Erckmann wrote several stories, among them being *Kaleb et Khora* and *La Première Campagne du Grand-père Jacques*.

ERDMANNITE, n. *ērd'man-īt* [named after Prof. Erdmann]: in mineral., name of two minerals; *Erdmannite of Berlin*, a variety of orthite; *Erdmannite of Esmark*; a variety of zircon.

ERE, conj. and prep. *är* [Goth. *air*, early; AS. *ær*, early, before: Dut. *eer*, sooner: Ger. *eher*, before; *erste*, first]: before; sooner than. **ERST**, ad. *ērst*, at first; in early times; once; long ago. **ERE LONG**, ad. *är'lōng*, a contraction for ‘before long time,’ or ‘before a long time shall elapse.’ **ERE now**, ad. before this time. **EREWHILE**, a. ad. *är-hwīl*, some time ago; a little while before.

EREBUS, n. *ēr'ē-būs* [L. in *anc. myth.*, the god of darkness, son of Chaos, and brother of Nox]: darkness; the region of the dead; hell; it denotes especially the gloomy cavern beneath the earth through which the shades of the dead were supposed to pass to Hades.

EREBUS, *ēr'ē-būs*, **MOUNT**, and **MOUNT TERROR**: volcanoes discovered by Sir James Ross while exploring Victoria Land, then supposed to be an antarctic continent, 1841, Jan., and named after the ships of his expedition; lat. $77\frac{1}{2}$ ° s. and long. $168^{\circ} 12'$ e. Mt. E. is 12,400 ft. high and was emitting flame and smoke when discovered, and Mt. T. is 10,900 ft. high, and inactive.

ERECHTHEUS, *ē-rēk'thūs*, or **ERICHTHONIUS**, *ēr-ēk-thō-nī-ūs*: mythical Attic hero, said to have been the son of Hephaestus and the Earth, and to have been reared by Athena. One form of the tradition states that when a child he was placed by Athena in a chest, which was intrusted to Agraulos, Pandrosos, and Herse, daughters of Cecrops, with the strict charge that it was not to be

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opened. Agraulos and Herse, however, unable to restrain their curiosity, opened the chest, and discovering a child entwined with serpents, they were seized with madness, and threw themselves down the most precipitous part of the Acropolis. Afterward Erechtheus was the chief means of establishing the worship of Athena in Attica. He is regarded as the founder of the Erechtheum, the temple of Athena Polias, guardian of the city.

This original ERECHTHEUM, which contained Erechtheus's tomb, and was called by his name, was burned by the Persians, but a new and magnificent temple was raised on the same site—north of the Parthenon, and near the n. wall of the Acropolis—in the beginning of B.C. 4th. c. The second Erechtheum was a splendid structure of the Ionic order, oblong, extending from e. to w., abutting in side chambers at the w. end, toward the n. and s., and having porticoes adorned with columns at its e., n., and s. extremities. It is now an utter ruin.

ERECT, v. ē-rěkt' [L. *erectus*, raised or set up—from *e*, out of; *rectus*, straight or upright]: to raise; to set up; to build; to found or establish: ADJ. in a perpendicular position; upright; firm, unshaken, or bold. **EREC'TING**, imp. **EREC'TED**, pp. **ERECT'LY**, ad. -lī, in an upright position. **ERECT'NESS**, n. the being perpendicular in position or form. **EREC'TABLE**, a. -tă-bl, that can be erected. **EREC'TILE**, a. -til, that which may be erected; having the property of raising itself. **EREC'TIVE**, a. -tīv, able or tending to erect. **EREC'TER**, n. -tēr, one who. **EREC'TOR**, n. -ter, a muscle that erects; he or that which erects. **EREC'TION**, n. -shūn [F.—L.]: the act of raising or building; settlement or formation; a building of any kind.—SYN. of 'erect, v.': to establish; found; elevate; construct; institute; lift up; set up; exalt; form; make.

EREC'TION, **LORDS OF**: those of the nobility in Scotland to whom the king, after the Reformation, granted lands, or tithes, which formerly belonged to the church. They were called also Titulars of Tithes; the gifts being not confined to the nobility. The grants were made under the burden of providing competent stipends to the reformed clergy—an obligation very little attended to by the grantees, prior to the decrees arbitral of Charles I., 1629. Ersk. B. ii. tit. 10, s. 18.

EREGLI, ēr'ēg-lē, or **EREKLI**, ēr'ēk-lē (anc. *Heraclea*): town of Asia Minor on the Black Sea, 128 m. e.n.e. of Constantinople, lat. 41° 15' 30" n., long. 31° 28' e., where Xenophon's army embarked on their return to Greece. It has a commodious harbor, large ship-building yards, and valuable coal interests, exports coal, timber, silk, and wax, and imports colonial produce, tobacco, and iron. Pop. 5,000.—**EREGLI** (anc. *Archalla*) is the name also of a town of Asiatic Turkey, 90 m. e.s.e. of Konieh, in the vilayet of the same name.—**EREGLI** (anc. *Perinthus*) is the name also of a town of Roumelia, European Turkey, on the Sea of Marmora, 55 m. w. of Constantinople; see of a Greek bishop.

EREMACAUSIS—ERFURT.

EREMACAUSIS, n. *ĕr'ĕ-mă-kaw'sis* [Gr. *erēmū*, silent, gentle; *kausis*, a burning]: the slow chemical change or combustion without sensible heat, caused by the action of the oxygen of the atmosphere on moist animal or vegetable bodies, as in the slow decay of wood. The process consists in the oxygen (O) of the air combining with the hydrogen (H) of the wood forming water (HO), and in less quantity with the carbon (C) forming carbonic acid (CO₂), leaving a brown mold or powder, called by chemists ulmin, or humus, in which carbon preponderates.

EREMITE, n. *ĕr'ĕ-mīt*: another spelling of HERMIT, which see.

EREMITE, n. *ĕr'ĕ-mīt* [Gr. *erēmos*, lonely, in allusion to its rarity]: in mineral., the same as MONAZITE (q.v.).

EREMUS, n. *ĕr'ĕ-mūs* [Gr. *erēmos*, solitary]: in bot., a ripe carpel partially detached from the rest.

ERETHISM, n. *ĕr'ĕ-thīz'm* [Gr. *erēthīsmos*, irritation]: in med., a state of irritation or excitement of a part, different from, or short of, the inflammatory condition, although often passing into it; unnatural energy of action. ERETHISTIC, a. *-thīs'tik*, pertaining or relating to erethism.

ERETHIZON, n. *ĕr-ĕ-thīz'ōn* [Gr. *erethizōn*, pp. of *erethizō*, I rouse, I fight]: in zool., genus of *Cercolabidæ*, a family akin to the *Hystricidæ*. *Erethizon dorsata* is the Canadian porcupine.

ERETRIA, *ĕ-rē'tri-a*: ancient city of Greece, on the w coast of the island of Eubœa, a few miles s.e. of Chalcis, with which it maintained a commercial rivalry many years. It was a rich and powerful city previous to the Trojan war, and was destroyed by the Persians for having assisted the Ionic cities in their revolt, B.C. 490. It was rebuilt s.e. of its old site, named New E., took an important part in the Peloponnesian war, and contained a famous school of philosophy.

ERF, n. *ĕrf*, ERVEN, n. plu. *ĕr'ven* [Dut.]: garden plot, usually containing about half an acre.

ERFURT, *ĕrfürt*: city of Prussian Saxony, anciently cap. of Thuringia; in a highly cultivated plain, on the right bank of the Gera, 14 m. w. of Weimar. Till 1873 E was strongly fortified, and was accounted a fortress of the second rank. Its two citadels, the Petersberg and the Cyriaksburg, were formerly monasteries. Among the numerous churches, the cathedral and the Church of St Severus are the finest. The cathedral is one of the most venerable Gothic buildings in Germany, and possesses, besides a very rich portal, sculptures dating from the 11th to the 16th c. Of the convents, only that of the Ursuline nuns remains. The monastery of St. Augustine, famous as the residence of Luther, whose cell was destroyed by fire 1872, was converted 1820 into an asylum for deserted children. The other remarkable buildings are, the university, founded 1378, suppressed 1816; the royal acad.; the library, containing 60,000 vols.; numerous educational establishments, infirmaries, etc. Horticulture and extensive trade in seeds.

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are carried on. The principal manufactures are woolen, silk, cotton, and linen goods, yarn, shoes, stockings, tobacco, leather, etc.

E. is said to have been founded in the beginning of the 5th c. by one Erpes, from whom it took its original name of Erpesford. During the middle ages, at the time of its highest prosperity, E. was strongly fortified, and contained 60,000 inhabitants. In 740, St. Boniface founded a bishopric at E.; and in 805 it was converted into an entrepôt of commerce by Charlemagne. It afterward belonged to the Hanse-league, then to the elector of Mainz, from 1801–06 to Prussia, and from that time till 1813 it was under French rule. E. was finally restored to Prussia by the Congress of Vienna. In the spring of 1850, the parliament of the states, which had combined together for union, held its sittings at Erfurt.—Pop. (1885) 58,385, (1900) 85,202.

ERG: see ELECTRICAL UNITS.

ERGASILIDÆ, n. *ér-ga-síl'i-dé*: family of crustaceans, placed under Milne Edwards's order *Siphonostomata*, now *Epizoa* or *Parasita*. Most of the species are parasitic on the gills of fishes, one on those of the lobster. ERGASIL' IUS, n. -*üs* [Gr. *ergasia*, work; daily labor]: genus of crustaceans, typical one of the family *Ergasilidæ*.

ERGO, conj. *ér'gō* [L.]: therefore; consequently; often used in a jocular way.

ERGON, n. *ér'gon*: occurs in composition, as *ergon-eight*.

ERGOT, n. *ér'göt* [F. *ergot*, cock's spur]: diseased condition of the germen of grasses, sometimes observed also in some of the *Cyperaceæ*. It begins to show itself when the germen is young; different parts of the flower assume a mildewed appearance, and become covered with a white coating composed of a multitude of minute spore-like bodies mixed with delicate cobweb-like filaments; a sweet fluid, at first limpid, afterwards viscid and yellowish, is exuded; the anthers and stigmas become cemented together; the ovule swells till it greatly exceeds the size of the proper seed, bursts its integuments, and becomes elongated and frequently curved, often carries on its apex a cap formed of the agglutinated anthers and stigmas, and assumes a gray, brown, purple, violet, and at length a black color, as the viscid exudation dries and hardens. The structure differs very much from that of the properly developed seed; the qualities are not less different, almost one-half of the whole substance consists of *fungin*; and the cells contain, instead of starch, globules of a peculiar fixed oil—OIL OF ERGOT, to which the remarkable qualities of ergot are supposed to be chiefly or entirely due. Oil of ergot forms about 35 per cent. of the ergot of rye. Ergot appears to have been observed first in rye, in which it becomes very conspicuous from the large size it attains, sometimes an inch or even an inch and a half in length. It is, however, not uncommon in wheat and barley, though in them it is not so conspicuous, from its general resemblance to the

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ordinary ripened grain. Rye-grass is often affected with ergot, as are many other grasses; and it is of frequent occurrence in maize, in which also it attains its greatest size.

Ergot has been supposed to be merely a disease occasioned by wet seasons or other climatic causes. But it appears now to be ascertained that it is a disease occasioned by the presence of the *mycelium* of a fungus; the spores of which may perhaps be carried to the flower through the juices of the plant, for there is reason to think that ergot in a field of grain may be produced by infected seed. Mr. Quekett, 1838, described a fungus, a kind of MOLD (q. v.), which he found in ergot, and to which he gave the name of *Ergotactia abortifaciens*. Link and Berkeley afterwards referred it to the genus *Oidium*; and they, as well as others, believed it to be the

Ergot of Rye.



true ergot fungus. The spores of this ergot mold, however, vegetate readily, under proper conditions of warmth and moisture, in situations very different from that in which ergot is produced; and its presence is perhaps a consequence rather than the cause of ergot. The true ergot fungus seems to have been discovered by Tulasne, who published a description of it 1853. That of the ergot of rye is called *Cordiceps* (or *Claviceps*) *purpurea*; its mycelium alone exists in ergot, but if the ergoted grains are sown, the fungus develops itself in its perfect form, growing in little tufts from the surface of the ergot, with stem about half an inch long, and subglobular head. Allied species appear to produce the ergot of other grasses.

Ergot is inflammable, burning with a yellow-white flame; the fixed oil which it contains, indeed, makes it burn readily if brought into contact with the flame of a candle. It is a valuable medicine, exercising a specific action on the womb, particularly during labor, and by the greater frequency and force of the contractions which it causes when cautiously administered, often most beneficially hastening delivery. This use of it is said to have originated—probably through accidental discovery—with a provincial female practitioner in France. Its introduction into British practice dates only from 1824. It is the ergot of rye which is always employed; also called SPURRED RYE, or *Secale cornutum*. It has been employed also as a sedative of the circulation, to check various kinds of hemorrhage. Ergot is administered in various forms—powder, decoction, extract, tincture, oil of ergot, etc.—In

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large or frequent doses, ergot is a poison, sometimes producing convulsions, followed by death; sometimes gangrene of the extremities, resulting in mutilation or in death. Ergot of rye consists of 35 per cent of a peculiar fixed oil, 1½ of ergotin, 46 of fungin, the remainder being gum, fat, albumen, salts, etc. Ergot treated with water yields a reddish-colored liquid with acid properties. In considerable quantities, it is a poison to the lower animals as well as to man. ER'GOTISM, n. -gō-tīz̄m, in *med.*, a diseased state of body caused by eating diseased or unripe grain, especially the poisonous effects resulting from eating bread made from spurred rye (see RAPHANIA). ER'GOTIZED, a. -tīzd, diseased by ergot, as rye. ER'GOTIN, n. -tīn, the acrid, bitter, active principle of ergot.

ERHARDT, ēr'hārt, JOEL B.: b. Pottstown, Penn., 1838: lawyer. He removed with his parents to New York when four years old, attended the public schools, was a clerk several years, studied law, and entered the Univ. of Vt. In 1861, Apr., he left the univ., enlisted in the 7th N. Y. regt., and served with it during its term, and on returning to New York was admitted to the bar. Shortly afterward he enlisted in the 1st Vt. cav., became capt., and resigned 1863. He was provost marshal of the 4th cong. dist., N. Y., 1863, Apr. 15–1865, May 1, and was then appointed asst. U. S. dist. atty. In 1876 he was appointed a police commissioner of New York. Mayor Ely preferred charges against E. and two other commissioners, on which they were tried but not removed. In 1879 other charges were preferred against him by a fellow-commissioner, and on the accession of Mayor Cooper he preferred charges against all the commissioners for mismanagement and incompetency. A long trial followed, but while the certificates of removal were awaiting Gov. Robinson's signature, a successor to E. was confirmed. In 1888, Nov., he was defeated as republican candidate for mayor of New York, and 1889, Apr., was appointed by Pres. Harrison collector of the port of New York. Though under repeated attack in the fierce political contests of New York, E. has high repute for integrity and executive ability. He resigned the collectorship 1891.

ERIAN, a. ēr'i-an: in *geog.* and *geol.*, pertaining to Lake Erie.

ERIC, *er'ik*: Scandinavian form of the name Henricus, Enrico, and Henry of southern nations. Many kings of the name reigned separately in Denmark and Sweden, and some ruled over the whole of Scandinavia after the union of Calmar. The two earliest rulers of the name in Denmark merit notice from their association with the introduction of Christianity.

ERIC I. (died 860) protected the Christians in the latter part of his reign, and, under the direction of the missionary Ansgar (q.v.) or Anscharius, founded the cathedral of Ribe, the first Christian church in the land. In his time the Northmen began those incursions into southern countries which were destined to exercise so permanent an influence on European history.

ERIC II. followed in the steps of his father, and permitted Ansgar to prosecute the labor of converting and civilizing the people, which won for him the title of the Tutelar Saint of the North. To Eric II. is ascribed the reorganization of those guilds which finally merged in the municipal corporations of the middle ages, but which were, at first, a mere modification of the heathen brotherhoods of the Scandinavian heroic ages, and constituted associations, whose members were a privileged class, separated by distinct laws, rights, and duties from the rest of the people.

In the 12th c. Denmark suffered in an equal degree from the two Erics who ruled over her, for while ERIC, surnamed Emun, exhausted the strength of the land by the indomitable pertinacity with which he endeavored, by force of arms, to compel the Vandals and other piratical neighbors to accept the Christianity which he thrust upon them, ERIC 'the Lamb' crippled the powers and resources of the crown by his pusillanimous subserviency to the clergy.

The three Erics (ERIC VI., VII., and VIII.) who occupied the throne 1241-1310, with only the intermission of a few years, are associated with one of the most disastrous periods of Danish history. Long minorities, the suicidal practice of dismembering the crown-lands in favor of younger branches of the royal house, and futile attempts to restrain the ever-increasing encroachments of the church, combined to bring the country to the brink of destruction. Eric VI. (Plogpenning) and Eric VII. (Glipping) were both assassinated, the former at the instigation of a brother, and the latter in revenge for a private injury. Eric VIII., last of the name before the union of Calmar, died childless, and was succeeded, 1319, by his ambitious brother Christopher, who saw himself compelled to repay his partisans at the expense of almost all the prerogatives and appanages which still belonged to the crown.

In Sweden, the first of the name who merits notice is King ERIC, surnamed the Saint, slain in battle 1161, after a short reign, which was signalized, in that age of anarchy, by the foundation of many churches and monasteries, and by the promulgation of an excellent code of laws, known as *St. Eric's Lag*. This law contained provisions by which a higher status in society was secured to women, by granting them a fixed proportion of the heritage of their male rela-

ERIC.

tives, and certain definite privileges within their households. St. Eric waged frequent war with the Finns, and compelled them to adopt the outward forms of Christianity. The two namesakes and descendants of St. Eric, who ruled in Sweden during the 13th c., and ERIC XII. (reigned 1350-59), have little claim to notice, for internal disturbances and wars with their neighbors brought about the same fatal results as those associated with the reigns of the Erics in Denmark during the middle ages.

In 1412, on the death of the great Margaret, her relative, ERIC of Pomerania, succeeded to the triple crown of Scandinavia, in accordance with the articles of the famous treaty of Calmar. The noble heritage that had been bequeathed to Eric required a firmer hand and a braver spirit than his to keep it in check; and his reckless disregard of treaties and oaths, his neglect of his duties, and his misdirected ambition, led, after years of dissensions, maladministration, and disaffection, to the inevitable result that Eric was declared to have forfeited the respective thrones of the several kingdoms, which proceeded to elect rulers of their own. The intestine wars which then arose plunged the whole of Scandinavia into anarchy, and sowed seeds of dissension among the three kindred nations, which bore fatal fruits in subsequent ages. The last ten years of Eric's life were spent in piracy in the island of Gothland, whither he had retired with his mistress and a band of followers, and whence he sent forth piratical expeditions to pillage both friends and foes. Eric married Philippa, daughter of Henry IV. of England, whose memory is still cherished in the north, on account of the many noble deeds with which local tradition associates her name.

ERIC XIV., the last of the name who reigned in Sweden, had the distinction of being at once one of the worst and one of the most unhappy of the name. He succeeded, 1560, to the throne of his father, Gustaf Vasa, perhaps the greatest and worthiest monarch that ever reigned over Sweden, and immediately on his accession he made known the difference that was so unfavorably to distinguish his reign from that of his father, by quarrelling with his brothers, thwarting the nobles, and opposing the lower orders. His fickleness and extravagance were evinced in a succession of embassies, which were in turn sent to almost every European court, to demand a consort for this vacillating monarch, who usually changed his mind before his envoys had time to fulfil their missions. Elizabeth of England and Mary of Scotland were more than once the objects of his matrimonial schemes; but when the resources of the country had been seriously crippled by these costly and absurd expeditions, Eric married a Swedish peasant-girl, who ultimately acquired an influence over him ascribed by the superstitious to witchcraft, since she alone was able to control him in his violent paroxysms of blind fury. It is probable that Eric labored under remittent attacks of insanity, and that to this may be attributed the bloodthirsty cruelty with which he persecuted those of his own relatives or attendants who fell under his suspicion. His capricious cruelties at length alienated the minds of his

Subjects, who, wearied with the continuous wars and disturbances in which his evil passions involved them, threw off their allegiance 1568, and solemnly elected his brother John to the throne. For nine years the unhappy Eric suffered every indignity at the hands of the keepers appointed by his brother to guard him, and in 1577 he was compelled to terminate his miserable existence by swallowing poison, in obedience to his brother's orders. Strange to say, this half madman was a person of cultivated understanding, and he solaced his captivity with music and the composition of psalms, and in keeping a voluminous journal.

ERIC, ēr'ik, THE RED: viking; one of the adventurous Norsemen who settled on the bleak shores of Iceland in 982: son of the Jarl (Eng. Earl) of Jadar: he was named from the color of his hair. He was soon in search of further adventure. Many years before, Gunnbjörn said that he had seen land to the west. Eric determined to take possession of it; and 983, with a party of daring followers, he started from Bredifjord in Iceland, sailed round Cape Farewell, and up the w. coast of the great peninsula or island, to which he gave the name Greenland. To-day the name seems a misnomer; but Eric saw herds of reindeer feeding in meadows, where Julianeshaab now stands. There Eric settled, calling the inlet Ericfiord. He returned to Iceland 985 to enlist fresh adventurers, and then succeeded in reaching Ericfiord with 14 vessels out of a fleet of 25, and built a town several miles up the fiord. The settlement flourished, and colonized several points along the coast. The climate at that time must have been milder, for the chronicles mention trees, and seldom allude to ice.—**LEIF ERICSON**, son of Eric the Red, was sent out by his father about the year 1000, in charge of an exploring expedition, and discovered the N. American continent, naming one place Markland, which has not been fully identified, but possibly was Nova Scotia; and another part Vinland, from the vines there growing wild, which was probably the s.e. part of New England. He is said to have planted a colony at the latter point, but the evidence has been much disputed. See, on the whole question, Laing's *Heimskringla*.

ERICA, n. ēr-ī'kū [L. *ericæus*, of heath or broom—from *ericē*, heath]: a genus of beautiful and interesting plants, ord. *Ericacææ*, or heath family, mostly natives of Cape of Good Hope.

ERICALES, n. ēr-ī-kā'lēz [mod. L. *erica*]: in bot., alliance of hypogynous exogens with dichlamydous flowers, symmetrical in the ovary, axile placentæ, definite stamens, and embryo inclosed in a large quantity of fleshy albumen. Lindley includes under it five orders, *Humiriaceæ*, *Epacridaceæ*, *Pyrolaceæ*, *Francoaceæ*, *Monotropaceæ*, and *Ericaceæ*.

ERICÆ.

ERICÆ, ē-rī'sē-ē, or ERICACEÆ, ēr-ī-kā'sē-ē: nat. ord. of exogenous plants, consisting chiefly of small shrubs, but containing also some trees. The leaves are opposite or in whorls, entire, destitute of stipules, often small, generally evergreen and rigid. The flowers are sometimes solitary in the axils of the leaves, sometimes grouped in different modes of inflorescence, and are often of great beauty, in which respect no order of plants excels this; the beauty of the smallest species, and of those which have very small flowers, rivalling that of others which are trees profusely covered with magnificent clusters. About 900 species of this order are known, of which the greater number are natives of s. Africa, which particularly abounds in the genus *Erica*, and its allies—the true heaths (q. v.)—though some of them are found also at the utmost limits of northern vegetation. They are rare within the tropics, and occur only at considerable elevations. Few species are found in Australia. Many of the E. are *social* plants, and a single species sometimes covers great tracts, constituting the principal vegetation. This is most strikingly exemplified in the heaths of Europe and the n. of Asia. Medicinal properties exist in some of the E., as the BEARBERRY (see ARBUTUS), and the GROUND LAUREL, of N. America (*Epigaea repens*), (see EPIGÆA REPENS), a popular remedy in the United States for affections of the bowels and urinary organs. Narcotic and poisonous qualities are frequent. See ANDROMEDA: AZALEA: KALMIA LEDUM: RHODODENDRON. The berries of some species are edible (see ARBUTUS: GAULTHERIA), though none are much esteemed.—The RHODODENDREÆ, classed sometimes as an order, are classed usually as a sub-order of E., containing genera *Rhododendron*, *Azalea*, *Kalmia*, *Ledum*, etc.: to it belong generally the larger plants of the order, also many small shrubs of sub-arctic regions.

ERICHSEN, ēr'ik-sēn, JOHN ERIC, M.D., F.R.S., LL.D.: eminent English surgeon and author; b. London, 1818. He was educated at the Mansion House, Hammersmith, and at University College, London; was appointed sec. to the physiological section of the British Assoc. for the Advancement of Science 1844; took the Royal Humane Society's gold medal with an essay on *Experimental Inquiry into the Nature and Treatment of Asphyxia* 1845; was appointed prof. of surgery and of clinical surgery in University College and surgeon to the hospital 1850; was a member of the royal commission on vivisection 1875; was pres. of the surgical section of the great international medical congress 1881; and was the unsuccessful candidate for parliament from the universities of Edinburgh and St. Andrew's 1885. He has been pres. of the Royal College of Surgeons of England and of the Royal Medical and Chirurgical Soc., is surgeon-extraordinary to Queen Victoria, and is a member of the principal surgical and scientific societies of the world. His *Science and Art of Surgery* has been translated into almost every known language.

ERICHT, ēr'īcht (or ER'ROCHT), LOCH: in the n.w. of Perthshire and s. of Inverness-shire, in an uninhabited district, the wildest and most inaccessible in Scotland, amid the Grampian Mountains. Its banks rise steeply from the water's edge. It is 14 m. long, nearly a mile broad, and extends s.w. from near Dalwhinnie, on the Dunkeld and Inverness road. By one outlet it joins Loch Rannoch, and by another it runs into Loch Lydoch, its waters ultimately reaching the Tay. It is about 1,500 ft. above the sea, and it never freezes. In a cave at the s. end of the loch, Prince Charles lay hid 1746.

ERICHTHIANS, n. ē-rik'thī-anz [Gr. *erion*, wool; *ichthus*, fish]: English name for the tribe of unicirassiated stomatopod crustaceans, the type of which is Erichthys. ERICH'THYS, n. -this, genus of stomatopoda. It contains the glass shrimps.

ERICINONE, n. ē-ri'si-nōn [L. *erica*; Eng. *quinone*]: in chem., crystalline substance obtained by the dry distillation of ericaceous plants. It has been found identical with hydroquinone, $C_6H_4(OH)_2$ (1·4): see HYDROQUINONE.

ERICSSON, ēr'ik-son, JOHN, LL.D.: 1803, July 31—1889, Mar. 8; b. Langbanshyttan, Sweden: engineer. He studied some time with a German officer of engineers; spent most of his time examining the machinery in his father's mines; was appointed a cadet in the corps of mechanical engineers when 12 years old, and a leveller on the great Swedish ship canal when 13; entered the army as ensign 1820; was promoted capt. 1827; and soon afterward resigned. His early inventions included a condensing-flame engine, a line-engraving machine, an instrument for sea-soundings, a hydrostatic weighing-machine, a tubular steam-boiler, and artificial draught by centrifugal blowers. He built the locomotive *Novelty* to compete with George Stephenson's *Rocket*, and invented and built a steam fire-engine 1829; introduced link motion for reversing loco-

ERIDANUS—ERIC.

mōtives 1830; perfected the famous caloric engine 1833, and built a vessel of 2,000 tons and propelled it with this motor 1853; invented the screw propeller, which revolutionized steam navigation, 1836; came to the United States 1839; and designed the screw-propelled war vessel, *Princeton*, with machinery below the water line 1841. Much of the machinery and all its arrangement were designed by him, and he also introduced numerous mechanical novelties and a 12-inch wrought-iron gun, with a similar carriage, which took up the recoil without breeching. He received the prize medal of the world's fair, London, for a variety of philosophical devices 1851; offered Napoleon III. the plans for a partially submerged iron-clad, revolving-turret war vessel 1854; and built for the U. S. govt., in 100 days, the little iron-clad *Monitor*, which defeated the Confederate iron-clad *Merrimac* in Hampton Roads 1862, Mar. 9. This vessel led to an immediate and radical revolution in the navies of the world. See TURRET-SHIP. In 1869 he built a large fleet of steam gun-boats for the Spanish govt., with which to guard Cuba; 1881 devised the war vessel *Destroyer* and her 16-inch submarine gun; and 1883 presented to the public as a contribution to applied science a device for obtaining steady power from the sun. He received his degree from Wesleyan Univ. 1862. Amid a great naval pageant in New York harbor, ordered by the U. S. govt., his remains were placed on board the new U. S. cruiser *Baltimore* 1890, Aug. 23, for transportation to Sweden, where they were received and interred with equally impressive public ceremonies.

ERIDANUS, n. ē-rīd'ā-nūs [Gr. *Eridānōs*, the river Po]: a winding constellation in the southern hemisphere.

ERIE, ē-rī: city, cap. of E. co., Penn.; on Lake Erie, between Buffalo and Cleveland; on the Lake Shore railroad; at terminus of the Philadelphia and E. and the E. and Pittsburg railroads; 117 m. n. of Pittsburg. E. is on a bluff, having a grand view of the lake, is laid out with broad streets at right angles with each other, and has several large and attractive parks. It is lighted with gas and electricity, and has a bountiful supply of water forced from the lake to the top of a tower 200 ft. high, and thence distributed through the city; cost \$750,000. The peculiarly advantageous location of E. has given it high rank as a shipping and manufacturing point. It is in the small part of the state that touches the lake, and it has the largest land-locked harbor on Lake E. The harbor has been greatly improved by the federal govt., and is now 5 m. long by 1 m. wide, depth 9 to 25 ft. Presque Isle, lying directly in front of the city, furnishes the means of ample protection. Two light-houses stand at the entrance to the harbor; and substantial wharves, where merchandise is transferred directly from vessels to cars, extend along the entire front. In 1900, there were 644 manufacturing establishments, employing \$20,418,016 in capital, 9,339 hands, paying \$4,574,625 in wages, and yielding products valued at \$19,053,202. The principal industries are man-

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ufactures of iron, including steam-engines, machinery, car wheels, car works and stoves, representing \$6,541,349 in annual value of products; and planing mill products valued at \$768,549 annually; beside brick, leather, organ, pump, furniture, and various kinds of wood-work factories, flouring and grist mills, 21 carpentering establishments, and 5 malt houses. Leading articles of shipment are lumber, bituminous and semi-bituminous coal, iron ore, petroleum, and manufacturing products, and these are conveyed by railroad cars, steamboats, and sailing vessels that ply regularly between E. and other ports on the great lakes. There are three national banks, cap. \$600,000; 1 state bank, cap. \$85,000, and 1 private bank. The city is divided into 6 wards, and governed by a mayor, a select council, and a common council. Its educational system includes a high school and over 50 grammar, primary, and evening schools. There are 30 churches, divided denominationally as follows: Rom. Cath., 7; Presb., 5; Meth. Episc., 4; Prot. Episc., 3 (and 1 mission); German Evang., Lutheran, and Bapt., each 2, the latter with 3 missions; and Jews, Evang. Lutheran, and Ref., German Evang. Lutheran, Unit. Breth., and Universalist, each 1. E. is the see of a Rom. Cath. bp., who has under his control St. Joseph's orphan asylum, St. Vincent's hospital, a Benedictine priory, St. Benedict's convent and St. Benedict's (female) Acad. The Young Men's Christian Assoc. is an active organization, with a library of over 5,000 vols. The public buildings include a custom house, marine hospital, city hospital, and jail. On the site of E. the French built a fort prior to 1749, known as Fort de la Presque Isle. A town was laid out 1795, a portion incorporated as a borough 1805, and the whole granted a city charter 1851. The fleet with which Com. Perry won his great victory on Lake E. during the war of 1812-15 was built and fitted out at E. Pop. (1860) 9,419; (1870) 19,646; (1880) 27,737; (1890) 40,634; (1900) 52,723.

ERIE, BATTLE OF LAKE: naval conflict, 1813, Sep. 10, between the United States and Great Britain near the Bass islands, at the w. extremity of the lake, 36 m. e. of Toledo. In the early part of the war Lieut. Oliver Hazard Perry, U.S.N., was placed in command of the American forces on the lake, with instructions to fit out a squadron of 9 vessels, for the maintenance of the naval supremacy of all the lakes. He built and equipped at Erie, Penn., the *Lawrence*, *Niagara*, *Caledonia*, *Scorpion*, *Ariel*, *Somers*, *Porcupine*, *Tigress*, and *Trippie*, having a total of 54 guns and 490 officers and men. Though Erie was blockaded by the British fleet at the time, Perry succeeded in getting egress for all his vessels, and proceeded to Put-in-Bay, near Sandusky. On Sep. 10 he discovered a British fleet of 6 vessels, the *Detroit*, *Queen Charlotte*, *Lady Provost*, *Hunter*, *Chippeway*, and *Little Belt*, lying in the offing, and immediately sailed to meet it. On the American side the *Lawrence* and *Niagara*, and on the British the *Detroit* and *Queen Charlotte* were regular vessels of war, the rest were small vessels hastily armed for warfare. The British vessels carried a total of 63 guns and 502 officers and men. The engagement was

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opened by the British, who directed their fire upon the *Lawrence* with such effect that within a short time all her guns were disabled and only 18 out of her force of 101 officers and men remained alive and uninjured. Perry then left the *Lawrence* in a small boat under heavy fire, and took command of the *Niagara*, and bringing his vessels together, passed through the line of British vessels, gave them a raking cross fire, and in 7 minutes compelled the surrender of the 4 principal opponents. The other 2 attempted to escape, but were pursued and captured an hour later. The battle lasted three hours, and the losses on each side were about 130 in killed and wounded, the British commander, Barclay, being among the latter. When Perry saw that victory was assured, he sent the memorable dispatch to Gen. Harrison: 'We have met the enemy and they are ours.'

ERIE, LAKE: most southern of the 5 great lakes drained by the St. Lawrence river; forming part of the boundary between the United States and Canada; bounded n. by the province of Ontario, Canada; s.e. and s. by N. Y., Penn., and O., and w. by Mich.; between lat. $41^{\circ} 25'$ — $42^{\circ} 55'$ n. and long. $78^{\circ} 55'$ — $83^{\circ} 34'$ w.; greatest length 290 m., greatest breadth 57 m., mean 40 m.; circumference 660 m.; greatest depth 312 ft., mean 120 ft.; surface elevation above sea level 565 ft.; area abt. 10,000 sq. m. It is the shallowest lake in the cluster, receives most of its water from Lakes Superior, Michigan, and Huron through the Detroit river, and has a surface 334 ft. higher than that of Lake Ontario, the descent being made in the connecting Niagara river. Beside the Detroit, the principal rivers emptying into it are the Maumee, Sandusky, Raisin, and Cuyahoga. It has several natural harbors that have been rendered valuable by govt. improvements, among which those of Erie, Penn., Dunkirk and Buffalo, N. Y., Cleveland, Sandusky, and Toledo, O., and Ports Maitland, Dover, Burwell, and Stanley, on the Canadian side, are the most important. L. E. occupies a very important position in the channel of trade and steam navigation. Large vessels can pass from it through the Welland canal into Lake Ontario, and thence by the St. Lawrence river and gulf into the Atlantic Ocean, while smaller ones can gain a lower ocean point by entering the Erie canal at Buffalo and the Hudson river at Albany, and making their way thence to New York. Both routes, however, are closed by ice three months during each year. On the other hand, the railroad facilities of its American ports are exceptionally large, and afford an uninterrupted communication with all parts of the United States. Customs districts are maintained by the U. S. govt. at Buffalo and Dunkirk, N. Y., Erie, Penn., and Cuyahoga, Miami, and Sandusky, O. At the w. extremity and near the mouth of the Detroit river, the lake contains a number of very fertile and heavily wooded islands, some under cultivation, and the largest having a circumference of abt. 14 m. Of these Point Pelee, North Harbor, East Sister, Middle Sister, and the Hen and Chicken Islands belong to Canada, and Kelly's, North, Middle, and South Bass, West Sister, Green, Sugar, and Rattlesnake Islands to the

ERIE CANAL—ERIGENA.

United States. It was at Put-in-Bay, South Bass Island, that Com. Perry discovered the British fleet under Capt. Barclay, 1813, Sep. 10, and his memorable battle was fought in its immediate vicinity. See ERIE, BATTLE OF LAKE.

ERIE CANAL: largest canal in the United States; commercially one of the most important and structurally one of the most scientific in the world. It extends from Buffalo to Albany, N. Y., 363 m.; was projected as a means of connecting the great lakes with the Hudson river and the Atlantic seaboard at New York, 1810; constructed under the provisions of a bill adopted in the state legislature, 1817; and completed 1825 at a cost of \$7,602,000. One of the earliest advocates and most constant promoters of the scheme was De Witt Clinton, who memorialized the legislature in its behalf 1815, and as gov. led an imposing naval demonstration down the Hudson from Albany and wedded Lake Erie to the Atlantic Ocean by pouring into the latter some water from the former, 1825, Oct. Originally it was 40 ft. wide at the surface and 4 ft. deep, but subsequent improvements gave it a surface width of 70 ft., bottom width 42 ft. and depth 7 ft. The flow of water is mostly from w. to e. its w. end at Buffalo being 568 ft. above its e. end at Albany. It is twice carried over Mohawk river on costly stone aqueducts; at West Troy it crosses a ridge 188 ft. high by means of 16 double lift-locks of remarkably skilful construction; and at Albany it is raised 20 ft. by 2 double locks, each 110 by 18 ft. Up to 1903 this canal had cost for construction, enlargements, and maintenance \$52,540,800. Of the \$9,000,000 appropriated in 1895 for canal improvements \$6,833,390 was spent on the Erie. The legislature of 1903 agreed to submit to popular vote a proposition to expend \$101,000,000 on the improvement of the Erie, the Oswego, and the Champlain canals, the bulk of which would be on the former.

ERIGENA, ē-rijē-na or ēr-ijē-na, JOANNES SCOTUS: famous philosopher of the middle ages; b. probably in Ireland; lived in the 9th c. Very little is known of his history. He appears to have resided principally in France, at the court of Charles the Bald. In the controversies of his time, regarding predestination and transubstantiation, he took part. His philosophic opinions were those of a Neo-Platonist rather than of a scholastic. His love for the mystic doctrines of the old Alexandrian philosophers was shown by his translation of the writings ascribed to Dionysius the Areopagite, which were a well-spring of mysticism during the middle ages. E. held that God is the essential ground of all things, from whom all things emanate, and into whom they return again. Pantheism, therefore, lurks in his system. His principal work is *De Divisione Natura* (published by Gale, Oxford 1681). One of its leading thoughts is the identity of philosophy and religion, when both are properly apprehended. E. uttered his opinions with great boldness, and he showed no less subtlety and strength of intellect in their defense. He expressed his contempt for theological dogmatism, and vindicated the authority of reason over all other authority. His words are: ‘Authority is derived from reason, and not reason from authority; and

ERIGERON—ERIOCAULACEÆ.

when the former is not confirmed by the latter, it possesses no value.' Consult Hjort's *Joh. E.* (Copenh. 1823); Staudenmayer, *Joh. E.* (Frankfurt 1834), and Taillandier, *Scot. E. et la Philosophie Scholastique* (Strasb. 1843); Möller, *Scotus E.* (1844); Christlieb, *Leben und Lehre des Scotus E.* (1861); and Huber, *Johannes E.* (1861).

ERIGERON, ē-rīj'ē-rōn: genus of plants of the nat. ord. *Compositæ*, suborder *Corymbiferæ*, having heads (flowers) of many florets, the florets of the ray numerous, in several rows, of a different color from those of the disk. *E. acris* is European, also a native around and n.w. of L. Superior. There are many N. American species; the most common are the tall, white-rayed Horse-weed, the Robin's Plantain, the Daisy Fleabanes, and the Common Fleabane (*E. philadelphicum*) with innumerable, narrow, rose-purple rays, and said to be used as a diuretic. The name Fleabane was given on the supposition that certain fetid species would drive away fleas. *Erigeron* was derived from the Greek, meaning Spring old man, referring to the hoary appearance of some vernal species.

ERIN, n. ē-rīn [L. *Ierne*, Ireland, the L. name being itself a probable corruption of an old Celtic term: comp. Gael. *Iar-innis*, the isle of the west, and *Hibernia*, Ireland]; contr. for Ireland, or its ancient name. **ERINITE**, n. ēr'ī-nīt, a beautiful green arseniate of copper found in Limerick, Ireland.

ERINA'CEUS and **ERINACE'ADÆ**: see HEDGEHOG.

ERINEUM, n. ēr-ī-nē'ūm [Gr. *erineos*, of wool; woolen]: in bot., abnormal development of the cells of the epidermis of trees, specially of the *Amentaceæ*, the *Aceraceæ*, and of the *Rosaceæ*. The cells so developed were formerly mistaken for fungi.

ERINGO: see ERYINGO.

ERINNA, ē-rīn'nā: Greek poetess, concerning the date of whose birth the most different statements are advanced. According to some, she was the intimate friend of Sappho (hence E. likewise is called the Lesbian singer), and was born at Rhodes, or on the little island of Telos, w. of Rhodes; while others maintain that she lived in the age of Demosthenes; and others again, perplexed by such a wide difference in point of time, have recourse to the hypothesis of two poetesses of this name. E. acquired such celebrity by her epic, epigrammatic, and lyric poems, that her verses were compared with those of Homer, though she died at the early age of 19. The genuineness of the fragments that exist under her name has been disputed on good grounds. These have been collected by Schneiderwin in the *Delectus Poesis Graecæ Elegiacæ* (Göttingen 1838). Compare Malzow *De Erinnæ Lesbiorum vita et Reliquiis* (Petersburg 1836).

ERINNYS, or **ERINNYES**: see EUMENIDES.

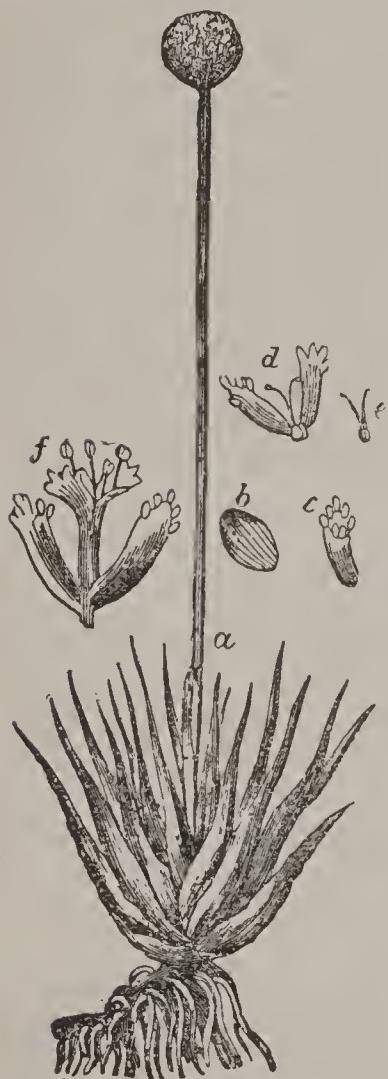
ERIOBOT'RYA: see LOQUAT.

ERIOCAULACEÆ, ēr-ī-ō-kaw-lā'sē-ē: nat. ord. of endogenous plants, nearly allied to *Restiaceæ*, containing about 200 known species, many of which are aquatic or marsh plants. The E. are natives chiefly of the tropical

ERIOCEPHALUS—ERIOPONUM.

parts of America and Australia. One species, *Eriocaulon septangulare*, JOINTED PIPEWORT, is found in the w. of Ireland, and in some of the Hebrides; a little grass-like plant, growing in lakes which have a muddy bottom, and exhibiting small globular heads of flowers. It is interesting from

its botanical affinities, and with reference to geographical distribution. The E. form a remarkable feature of the vegetation of some parts of S. America; but many of the species bear little resemblance to their humble northern congener, being almost shrubby, 4–6 ft. high, with leafy, much branched stems, ‘each branchlet terminated by a large white ball, composed of a vast number of smaller heads, placed on peduncles of unequal length.’ Many grow on arid mountainous regions; others in flat sandy grounds, flooded in the wet season.—Gardner’s *Travels in Brazil*.



Jointed Pipewort (Eriocaulon septangulare):

a, tuft of leaves, flower-stalk with flowers, and part of creeping root; b, seed; c, dies, is sometimes called *E. Indicum*, and another found in Africa, *E. Guineense*, is a tree of great height, 150 ft. or more. The African variety or species is called RIMI and BENTANG. Park mentions it by the latter name. Barth says it is generally seen growing near the principal gate of large towns in Hansa. Its wood is soft and spongy, used chiefly for making canoes. The seeds of *E. Indicum* are eaten in Celebes. They are roundish, and of the size of peas. The trees of this genus have palmate leaves. The flowers are large and beautiful.

ERIOCEPHALUS, n. ēr-i-o-sēf'-a-lūs [Gr. *erion*, wool; *kephalē*, the head]: in bot., typical genus of *Eriocephaleæ*, a sub-tribe of *Asteraceæ*, tribe *Senecionideæ*.

ERIODENDRON, ēr-i-ō-děn-drūn: genus of trees of the nat. ord. *Sterculiaceæ*, natives of tropical countries. Their thick woody capsules contain a kind of wool surrounding the seeds; hence the trees are sometimes called WOOL-TREES. The wool of *E. Samanna* is used in Brazil for stuffing pillows. *E. anfractuosum*, of which one variety, found in the E. In-

creeping root; b, seed; c, dies, is sometimes called *E. Indicum*, and another found in Africa, *E. Guineense*, is a tree of great height, 150 ft. or more. The Afri-

can variety or species is called RIMI and BENTANG. Park mentions it by the latter name. Barth says it is generally seen growing near the principal gate of large towns in Hansa. Its wood is soft and spongy, used chiefly for making canoes. The seeds of *E. Indicum* are eaten in Celebes. They are roundish, and of the size of peas. The trees of this genus have palmate leaves. The flowers are large and beautiful.

ERIOPONUM, n. ēr-i-ōg'o-nūm [Gr. *erion*, wool; *gonu*, the knee, a joint of a plant]: typical genus of *Eriogoneæ*, a tribe of *Polygonaceæ*.

ERIOLÆNEÆ—ERIVAN.

ERIOLÆNEÆ, n. ēr-ī-o-lē'nē-ē [mod. L. *eriolæna*]: a tribe of *Bytneriaceæ*.

ERIOMETER, n. ēr-ī-ōm'ē-tēr [Gr. *erion*, wool; *metron*, a measure]: instrument for measuring the diameter of small fibres, such as wool, cotton, or flax, by ascertaining the diameter of any one of the colored rings which they produce.

ERIOMYS, n. ēr-ī-o-mīs [Gr. *erion*, wool; *mus*, a mouse]: in zool., genus of *Chinchillidæ*. *E. laniger* is the chinchilla.

ERIOPHORUM, n. ēr-ī-ōfēr-ūm [Gr. *erion*, wool; *phoros*, bearing]: in bot., cotton-grass; genus of *Cyperaceæ* (sedges), tribe *Scirpeæ*. It consists of perennial tufted herbs, with many-flowered spikelets; the glumes imbricated on every side, and several hypogynous bristles, becoming very long and silky. The common *E. angustifolium* is reduced by Sir Joseph Hooker to a variety of *E. polystachyon*. *E. vaginatum* is the Hare-tail, *E. alpinum* the Alpine, *E. polystachyon* includes both the Broad and the Narrow-leaved, and *E. gracile* is the slender Cotton-grass. The silk or cotton from the English species of the genus has been made into paper and the wicks of candles, or used for stuffing pillows. The immature leaves of a Himalayan species, *E. comosum* or *cannabinum*, are used for rope-making.

ERIPHIA, n. ērifē-a [L. *eriphia*; Gr. *erepheia*, an unknown plant]: in zool., genus of decapod short-tailed crustaceans. *Eriphia spinifrons* is widely diffused in different seas.

ERISMA, n. ē-rīz'ma [Gr. *erisma*, a cause of quarrel; *erizō*, I strive; *eris*, strife: so called from the anomalous character of the structure first described and the genus of *Vochysiaceæ*]: in bot., the rachis or axis of grasses.—*E.* is also a genus of S. American *Vochysiaceæ*. *E. Japura* is the Japura of Brazil, a fine tree, 80 to 120 ft. high.

ERIVAN, or ERIWAN, ēr-ē-vān', or IRWAN: govt. of Russia in Transcaucasia; bounded by Georgia, Persia, and Turkish Armenia; watered principally by the Aras or Araxes river. It abounds in gold, silver, other minerals, and salt, and contains the celebrated Mt. Ararat. More than one-quarter of the population are tribes of nomadic gypsies of Mohammedan faith, the remainder are pure Armenians. Cap. Erivan.—Pop. of govt. (1897) 804,757.

ERIVAN, or ERIWAN, or IRWAN (Persian, *Rewán*): fortified cap. of Russian Armenia; n. of Ararat, in the elevated plain of Aras or Araxes, lat. 40° 10' n., long. 44° 32' e., 3,312 ft. above the sea. It consists of the town, properly so called, and the fortress, which is surrounded on three sides by high walls, and provided with aqueducts; a stone bridge over the Zenga, which here falls into the Araxes; barracks, three mosques, one of which has been converted into a Russian church, the palace of the Sardar, and a bazaar. The people are engaged in agriculture and commerce. E. was formerly cap. of the Persian province of Aran, celebrated for its silk. In the beginning of the 16th c., the khan Rewan, at the command of Ismael, shah of Persia, erected a strong fortress, which he called after his

ERLANGEN—ERLAU.

own name. An Armenian school was established at E. 1629, but transferred to Ejmiadzin 1631. During the last war between Russia and Persia, E. was stormed by the Russian gen. Paskewitsch, who received the surname of Eriwanski; and by the treaty of peace concluded at Turkmanjai, 1828, Feb. 22, it was given up by Persia to Russia, with the province of the same name. It is now an important Russian post, as in former times it formed the bulwark of Persia against the Turks, and afterward against Russia. In 1840, it was much devastated by an earthquake.—Pop. (1891) 15,040.

ERLANGEN, *är'läng-en*: town of Bavaria, in a well cultivated district, on the right bank of the Regnitz, 10 m. n. of Nürnberg. It is a handsome town, surrounded by walls pierced by seven gates; its streets—a great number of which were erected after 1706, when a fire consumed a large portion of the town—are straight and regular. It is divided into the Old and New Towns, the latter founded 1686 by Christian, markgraf of Bayreuth. E. is the seat of a univ., of a gymnasium, of agricultural and industrial schools, and other institutions. The univ. is the chief building. It was founded 1742, and is celebrated as a school of Prot. theology, is attended by 400 to 500 students, has a library containing 140,000 vols. and 1,000 manuscripts, and also zoological and mineralogical collections, etc. E. owes its prosperity to the migration thither of a number of refugees from France, who fled on the revocation of the Edict of Nantes, and who introduced many new branches of manufacture. Besides its extensive stocking and glove manufactories, which provide the greater part of Germany with their goods, E. has great mirror and tobacco factories, and manufactures of combs and hardware. E. became a Bavarian possession by the treaty of 1809. Pop. (1880) 14,876; (1885) 15,814; (1890) 17,559.

ERLANITE, n. *är'lan-it* [named from *Erla* in the Saxon Erzgebirge, where it is found]: in min., light greenish-gray mineral or rock containing silica, alumina, lime, etc. At first it was considered a mineral, but Dana believes it to be a rock. If the latter view ultimately prevail, the spelling will probably be changed to Erlanyte, the termination *-yte* being the modification of *-ite* adopted to distinguish rocks.

ERLAU, *är'lōw* (Hung. *Eger*): episcopal city of Hungary, county of Heves, of which it is cap.; on both banks of the river Erlau, in a delightful valley skirted with vine-clad hills. It is surrounded by old walls pierced by six gates; has four suburbs, in which the greater portion of the inhabitants dwell; and though in general its streets are narrow and have a neglected appearance, it is rich in fine public buildings. The principal of these are the Lyceum, with a valuable library, and an observatory 172 ft. high; the recently built cathedral, the episcopal palace, the Franciscan and the Minorite monasteries, a richly embellished Greek church, a county hall, and the new barracks. E. has also a gymnasium, an episcopal seminary, a normal and drawing school, a hospital founded 1730, which has a

ERLKÖNIG—ERMINE.

fund of nearly 400,000 guilders, and other important institutions. The two baths, the *Turkenbad* and the *Bischofsbad*, both much resorted to during the bathing-season, are supplied from two warm springs which rise from the bank of the Erlau. The cultivation of the vine is the principal occupation. The E. wine, the best red wine of Hungary, is produced in considerable quantities, and is in request in foreign countries. There are also manufactures of linens, woolens, hats, etc., and an important weekly market. The people mostly are Rom. Cath. in religion, and Magyar in race. E. owes its importance to the very old bishopric founded here by St. Stephen in the beginning of the 11th c., and which, 1804, was raised to an archbishopric. Pop. (1880) 20,669; (1890) 22,427.

ERLKÖNIG, *erl-kö-nich* [Elf-king]: German name of a poetical, personified, natural power which, according to German poetical authorities, prepares mischief and ruin for men, and especially for children, through delusive seductions. The name, not connected with the root *erle*, is synonymous with Elfen König. The E. was introduced into German poetry from the Sagas of the North, through Herder's translation of the *Erlkönig's Daughter* from the Danish, and has become universally known through Goethe's ballad of the *Erlkönig*.

ERMELAND, *er'meh-lānt*: ancient division of Poland, 1,600 sq. m. It is now in the Prussian province of Konigsberg, and forms a Rom. Cath. diocese. Pop (1885) 225,076.

ERMENONVILLE, *er-méh-nōng-vēl'*: village in the s.e. of the dept. of Oise, France, in the possession of the Girardin family. It is celebrated for beautiful and extensive parks, and as the resting-place of Rousseau, for which reason it is much visited in summer by strangers from Paris. It was also the residence of Gabrielle d'Estrées, the mistress of Henry IV., who inhabited a hunting-tower, part of which, still standing, bears her name. It became still more celebrated after the death of Rousseau 1778. During the revolution, his ashes were removed to the Pantheon, but conveyed back to E. after the restoration. It had nearly been purchased by the *Bande Noire*, but a larger sum was offered by Stanislaus de Girardin, the well-known liberal deputy, and E. was preserved for the lovers of art, of nature, and of historical monuments.

ERMINE, n. *ér'min* [OF. *ermine*; F. *hermine*—from mid. L. *armēniūs*, a fur of Armenia], (*Mustela erminea*): the stoat, a species of weasel (q.v.), considerably larger than the common weasel, but much resembling it in general form and other characters, and in habits. The E. is almost ten inches in length, exclusive of the tail, which is fully four inches and a half long. It is of a pale reddish-brown color in summer, the under parts yellowish-white, the tip of the tail black: in winter—in cold countries or severe seasons—the upper parts change to yellowish-white or almost pure white, the tip of the tail, however, always remaining black. This change takes place more frequently in northern than in southern localities, but sometimes even

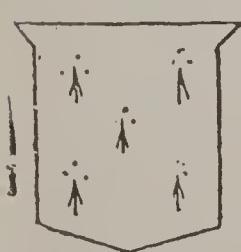
ERNE.

in the south of England; and when it is only partially accomplished, the animal has a piebald appearance, and often remains so during the milder winters. It is in its winter



Ermine:
Summer and winter dress.

dress that it is called E., and yields a highly valued fur; more valuable, however, when obtained from the coldest northern regions than from temperate countries. In its summer dress it is called Stoat. It displays indomitable perseverance in the pursuit of its prey, which consists very much of rats, water-voles, and other such small quadrupeds; with young hares and rabbits, grouse, partridges, etc. The eggs of birds are as welcome to it as the birds themselves. The E. is a native of all the n. parts of the world. Its range extends even to the s. of Europe. It delights in Moorish districts, and is abundant in the n. of Scotland. It is from Norway, Lapland, Siberia, and the Hudson's Bay territories that the E. skins of commerce are obtained, used not only for ladies' winter garments, but for the robes of kings and nobles, and for their crowns and coronets. E. has thus obtained a distinct recognition in heraldry. Being used for the robes of



judges, it has come to denote the judicial office or dignity, and to be an emblem of purity and honor without stain. In making up E. fur, the tails are inserted in a regular manner, so that their rich black shall contrast with the pure white of the rest of the fur.—*Ermine*, in heraldry, white fur, with black spots; the reverse of which,

Ermine. or a black fur with white spots, also used in heraldry, is called *Contre Ermine*. Ermine is commonly used to difference the arms of any member of a family who is connected with the law. A cross composed of four ermine spots is said to be a Cross Ermine. ER'MINED, a.-*mind*, adorned or clothed with ermine.

ERNE, *érn*: river and lake in the s.w. of Ulster province, Ireland. The river rises in the s. of Cavan county, in the small but beautiful Lough Cowna. It runs n. and n.w.,

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merging in Lough Oughter, in Cavan county, and in Lough Erne in Fermanagh county, and passes Enniskillen and Ballyshannon. It then flows through the s. corner of Donegal county into Donegal Bay; total course 72 m. On the river, at Ballyshannon, is a salmon-leap fall, over a rocky ledge 20 ft. high and 150 yards broad, and the river leaps over another rocky ledge near Belleek, $2\frac{1}{2}$ m. below the lower end of the loch. Lough Erne, one of the finest lochs in the kingdom, is the most attractive feature of Fermanagh county, which it bisects lengthways, and almost entirely drains. It extends 40 m. from s.e. to n.w., and consists of two lakes, the upper and lower, joined by a narrower part 10 m. long, and assuming in parts the character of a river, with Enniskillen midway between the two lakes. The Upper Lough is 12 by 4 m. in extent, 10 to 75 ft. deep, 151 ft. above the sea, and has 90 green hilly islets. The Lower Lough is 20 by $7\frac{1}{2}$ m. in extent, 100 to 266 ft. deep, 148 ft. above the sea, and has 109 islets. On one of the islets is a round tower. The waters contain salmon, trout, pike, bream, and eels. The scenery is singularly varied and beautiful.

ERNE, *ern* (*Haliaëetus*): genus of birds of the family *Falconidæ*, and of the eagle group; differing from the true eagles in the greater length of the bill, in the toes and lower part of the tarsi being destitute of feathers, and generally, also, in frequenting the sea-coast and the banks of lakes and rivers to feed on fish, in feeding like vultures on carrion almost as readily as on newly killed prey, and in inferior courage. The northern hemisphere has the COMMON E. (*H. albicilla*), known also as the Sea Eagle or



Common Erne (*Haliaëetus albicilla*).

White-tailed Sea Eagle. It is much more common in Britain than the Golden Eagle, is sometimes seen even in the s. of England and in inland districts, occasionally visiting deer-parks to prey on very young fawns or to

ERNESTI.

devour dead deer; but is more frequent in the n. of Scotland, doing considerable injury to flocks in Sutherlandshire, particularly during the season of young lambs. Its favorite haunts, where it roosts and makes its nest, are the shelves and ledges of stupendous precipices on the coast, where its scream often mingles with the noise of the perpetual surge. It sometimes also breeds on crags beside inland lakes, as at the Lakes of Killarney, and more rarely even on trees. Fishes are certainly its favorite food, though its mode of procuring them is not well known; but water-fowl also are its very frequent prey. It is found in most parts of Europe, and even in the islands of the Mediterranean, but is more abundant in the n. of Europe and Siberia. It occurs in N. Amer. only in Greenland. In size, the E. is inferior to the Golden Eagle, being seldom more than 33 inches in its whole length. The general color of the plumage is brown, the head having a paler yellowish tinge, the tail in the adult bird is pure white. The young, called sometimes the Cinereous Eagle, has a grayer plumage and mottled tail.—Another notable species of this genus is the WHITE-HEADED E. (*H. leucocephalus*) of America, called also the White-headed Eagle, Bald Eagle, and Sea Eagle, the chosen symbol of the United States. It is a bird of about the same size with the Common E., with dark-brown plumage, and—in an adult state—the head, neck, tail, and belly white. It is found in almost all parts of N. America, visiting the arctic regions in summer, but abounding chiefly in the southern states between the Atlantic and the Mississippi. It frequents both the sea-coast and the lakes and rivers, and may be often seen sailing through the column of spray at the Falls of Niagara. It is very fond of fish, which it procures by wading in shallow streams, and also by compelling the osprey to relinquish prey just taken. The soaring and evolutions of the birds in the air on such occasions are described as sublime. The White-headed E. feeds also on lambs, fawns, poultry, etc.; kills swans, geese, and other water-fowl; and does not disdain to compel vultures to disgorge for its use the carrion which they have swallowed. On account of its habits and dispositions, Franklin expressed his regret that it had been chosen as the symbol of his country. A Bald Eagle, of large size and young coloring, was named by Audubon the Bird of Washington (*H. Washingtonii*).—Australia produces a beautiful species (*H. leucogaster*), and numerous species are found in other parts of the world, among which are some of comparatively small size, as the PONDICHERRY KITE, or BRAHMANY KITE (*H. ponticerianus*) of India, constantly seen fishing like a gull in the rivers of that country, and by the Hindus considered sacred to Vishnu.

ERNESTI, ēr-nēs'tē, JOHANN AUGUST: 1707, Aug. 4—1781, Sep. 11; b. Tennstädt, in Thüringia: theologian and philosopher. He studied at Pforta, Wittenberg, and Leipsic; but after having been appointed rector of the Thomas-school in Leipsic, 1734, turned his attention chiefly to the old classic literature, and the studies connected with it.

ERNST.

In 1742, he became prof. extraordinary of ancient literature in the Univ. of Leipsic, in 1756 prof. of rhetoric, in 1759 prof. of theology. E. paved the way to theological eminence by a thorough study of philology, and was thus led to a more correct exegesis of the biblical authors, and to an interpretation less hampered by theological opinion. Mainly to him is due the present method of theological exposition, so far as it rests upon correct grammatical elucidation. He showed his ability as an accurate critic and grammarian, in his editions of Xenophon's *Memorabilia of Socrates*; the *Clouds* of Aristophanes, *Homer*, *Callimachus*, *Polybius*, *Suetonius*, and *Tacitus*; but above all, by his admirable edition of Cicero (5 vols. Leip. 1737-39), to which he added a *Clavis Ciceronia*, by way of supplement. He was also the first reviver of true and manly eloquence in Germany. His theological writings are numerous. The most remarkable are the *Initia Doctrinae Solidioris*, the *Institutio Interpretis Novi Testamenti* (translated into English), the *Anti-Muratorius* (1755), and the *Opuscula Theologica* (1792). Compare Bauer, *Formulae ac disciplinae Ernestianæ indoles* (1782); Stallbaum, *Die Thomas-schule zu Leipzig* (1839).

ERNST, ērnst, Elector of Saxony: d. 1486: founder of the Ernestinian line, or the elder branch of the princely House of Saxony. He was the elder son of the Elector Friedrich the Mild, and of Margaret, Archduchess of Austria. When only 14 years of age, he was seized and carried off from the castle of Altenburg, with his brother Albrecht, but was speedily recaptured. This incident, known in German history as the Stealing of the Princes (*Prinzenraub*), was described with extraordinary vividness by Carlyle in the *Westminster Review*, 1855, Jan. He succeeded to the electoral dignity on the death of his father 1464, but governed in common with his brother for 21 years. In 1485, however, E. and Albrecht divided the paternal possessions, when the former obtained as his share Thuringia, the half of the district then called Osterland, with Voigtländ, the Franconian estates of the House, the electoral dignity, and the dukedom of Saxony. E. took great interest in the welfare of his people. Against injustice, tyranny, and lawlessness, he was implacable. He died at Kolditz. It is next to impossible to trace the course of the Ernestinian line through the labyrinthine mazes of the endless German genealogies; it is sufficient to say that after 1638 the Ernestinian line was represented by the Dukes of Weimar, who gradually obtained the whole possessions of the House. Johann, Duke of Weimar (d. 1605), left several sons, the eldest of whom, Wilhelm, became founder of four different branches, all, however, reunited under Ernst August, Duke of Weimar (d. 1748). After 1815, the duchy of Weimar became the grand-duchy of Saxe-Weimar-Eisenach, and its present ruler is of course the direct representative of the Ernestinian line. The other three families by which also it is now represented are those of Meiningen, Saxe-Coburg-Gotha, and 'tenburg.

ERNST I.—ERNST II.

ERNST I., surnamed the Pious: Duke of Saxe-Gotha and Altenburg, founder of the House of Gotha; 1601, Dec. 24—1675; b. at the castle of Altenburg; son of Johann, Duke of Weimar (d. 1605); thus connected with the main Ernestinian line. E. was the ninth of ten brothers, the youngest of whom was the famous Bernhard (q.v.) von Weimar. He received an excellent education from his mother, Dorothea Maria von Anhalt. After the arrival of Gustavus Adolphus in Germany, E. entered the Swedish service, and in various engagements showed great courage and skill, completing the victory of the Protestants at Lützen, after the fall of Gustavus. After the battle of Nördlingen, 1634, Aug. 26, E. withdrew from the theatre of strife, and for the rest of his life applied himself to restoring the prosperity of his territories, frightfully devastated during the Thirty Years' War. Of his seven sons, the eldest, Friedrich, continued the line of Gotha, while the third became the founder of the House of Meiningen, and the seventh, the founder of the House of Saalfeld. E. is a fine type of the old German Prot. prince. Zealously attached to the doctrines and government of the Lutheran Church, he exercised a constant watch over its religious and educational interests. With the formalism, however, that often characterizes 'strictly religious' people, he compelled his children to learn the whole Bible by heart. He was much interested in the advance of Christianity abroad, and invited to his court the Abbot Gregorius from Abyssinia, besides sending thither on a religious embassy Joh. Mich. Wansleb of Erfurt. He also carried on a correspondence with the king of Ethiopia and the Patriarch of Alexandria. His line became extinct by the death of Friedrich IV. 1825.

ERNST II. (AUGUST KARL JOHANNES LEOPOLD ALEXANDER EDUARD): Duke of Saxe-Coburg-Gotha; b. Coburg, 1818, June 21; elder brother of the late Prince Albert (q.v.). Both brothers received an admirable literary and scientific education. The family to which E. belongs is a branch of the Ernestinian line, having been founded 1680 by Albrecht, second son of Ernst the Pious (q.v.). When E. had completed a university curriculum at Bonn, he entered the military service of the king of Saxony, but left it on his marriage with the daughter of the Grand-duke of Baden. In 1844, E. succeeded his father as Duke of Saxe-Coburg-Gotha. In his opinions and aspirations, imbued with the spirit of his age, he has introduced into his little dominions many beneficial reforms, and allayed not a few long-standing jealousies. Yet one regrets to say, that his enlightened views of his duty as a ruler have not been generally appreciated by his subjects. During the stormy period of 1848-9, by spontaneous concessions on the one hand, and on the other by energetic repression of the political anarchists, he succeeded in saving his territories from the perils of revolution. In the Slesvig-Holstein war, E. took a prominent part, and won the Battle of Eckendorf, 1849, Apr. 5. E. was a great advocate for the unity of the German nation, and prominent in most of the efforts made in that direction. His leisure hours are devoted to music and the fine arts.

ERNST—EROS.

His operas, *Casilda*, *Santa Chiara*, and *Diana von Solanges*, are well known in Germany. In 1861 he published a pamphlet vindicating his government, and in 1864 an account of a tour in Egypt.

ERNST, HEINRICH WILHELM: 1814–1865, Oct. 8; b. Brünn, Moravia; violinist. He studied at the Vienna Conservatorium. At the age of 16, his talents excited much interest in Germany; and he soon afterward performed in Paris. His first visit to London was in 1843; and he returned in subsequent years, spending the intervals in Paris and in different parts of Germany. His playing was characterized by immense brilliancy, combined with passion and sentiment. He suffered much from acute neuralgia, which latterly interfered with the exercise of his art; and the last seven years of his life were spent at Nice, where he died. E.'s compositions have generally a bravura character, and include works for the violin and orchestra, quartets, etc.

ERODE, v. ē-rōd' [L. *erōdērē*, to consume or eat away—from *e*, out of; *rōdō*, I gnaw]: to eat in or away; to corrode. ERO'DING, imp. ERO'DED, pp.: ADJ., in *bot.*, irregularly toothed as if gnawed. ERO'SIVE, a. -zīv [L. *erōsus*, consumed]: that eats away. ERO'SION, n. -zhūn [F.—L.]: act of gradually wearing away; state of being gradually worn away; influence of a stream or river in hollowing out its channel. Even the smallest streams, running over soft strata, as clay or sand, cut out channels, and remove the eroded materials. Hollows thus produced have been observed among stratified rocks. One in the coalfield of the forest of Dean has been carefully described. The trough was found to branch, when traced in the progress of mining, over a considerable area, and to assume all the appearances of a little stream, with small tributaries falling into it. When the hollows thus abraded are of considerable extent, '*valleys of erosion*' are produced. Many of the earlier geologists held that rivers had hollowed out their own valleys. The immense amount of materials brought down by rivers, and deposited at their mouths as deltas, shows without doubt that they have contributed materially to produce inequalities on the earth's surface; but the examination of the geological structure of valleys, plainly testifies that almost every great hydrographical basin has derived its form originally from some other agency, though its outline may have been much altered by the continued action of currents within it. EROSE, a. ē-rōs', in *bot.*, irregularly toothed as if gnawed or bitten. EROSE'LY, ad. -lī.

ERODIUM, n. ē-rō'di-ūm [Gr. *erōdios*, a heron, to the bill of which the beak of the fruit presents some resemblance]: in *bot.*, stork's bill, genus of *Geraniaceæ*. About 50 species are known, all from the e. hemisphere.

EROPHILA, n. ēr-ōf'i-la [Gr. ēr, ear, the spring; *phileō*, I love]: in *bot.*, genus of crucifers, family *Drabidæ*. It resembles *Draba*, but has deeply cloven white petals, etc., seeds numerous in each cell of the pod. *Erophila verna*, formerly called *Draba verna*, is the common Whitlow-grass.

EROS: see CUPID.

EROSTRATUS—ERR.

EROSTRATUS: see HEROSTRATUS.

EROTIC, a. *ě-rōt'ik* [Gr. *erōtikos*, relating to love—from *erāo*, I love passionately; *érōs*, love]: relating to the passion of love; produced by love; designating love-songs; also EROTICAL, a. *-i-käl*. EROTOMANIA, n. *ě-rōt'ō-mā'nī ā* [Gr. *manīā*, madness]: madness produced by love (see MANIA). EROTOMA'NIAC, n. *-nī-ăk*, one who is mad from love.

EROTYLIDÆ, n. *ěr-o-tíl'ř-dē* [L. *erotylus*, an unknown precious stone; Gr. *erōtulos*, a darling; a sweetheart, from the beauty of some of the species]: in entom., family of tetramerous beetles, with very gibbous bodies, found in fungi. EROTYLUS, n. *ě-rōt'i-lūs*, the typical genus of the family *Erotylidae*.

ERPENIUS, *ěr-pē'nī-ūs* (Latinized from Thomas van Erpen): 1584, Sep. 7—1624, Nov. 13; b. Gorkum, Holland: early Orientalist. At an early age, he was sent to Leyden, where he directed his attention first to theology, afterward particularly to Oriental languages. After travelling through England, France, Italy, and Germany, he became prof. of Oriental languages at Leyden, 1613. Here he erected an Arabic press in his own house, caused new types to be cut, and not only wrote but printed a great number of important works bearing on his favorite studies. The professorship of Hebrew not being vacant at the time of E.'s translation to the Univ. of Leyden, a second Hebrew chair was founded expressly for him 1619. Soon after this he was appointed Oriental interpreter to the govt., in which capacity he read and wrote replies to all official documents from the East. Such was the elegance and purity of his Arabic, that it is said to have excited the admiration of the emperor of Morocco. Toward the close of his life, tempting offers of honors and distinction came pouring in upon him from all parts of Europe; but he was never prevailed upon to leave his native country, where, in the midst of an eminent career, he died. Although the present standard of Oriental knowledge in Europe is much in advance of that of E.'s day, there is no doubt that the impetus of advance has been due principally to him. With hardly any better material than a few awkwardly printed Arabic alphabets, he contrived to write his famous grammar (*Grammatica Arabica, quinque libris methodice explicata*, Leyden 1613; recent ed. by Michaelis, Gött. 1771), which for 200 years, till the time of Siivestre de Sacy, kept undisputed supremacy; and there are many who think his *Rudimenta* unsurpassed, even to-day, as a work for beginners. Among his other important works the best known is his *Proverbiorum Arabicorum Centuriae Duæ* Leyden 1614).

ERPETOLOGY, n. *ěr'pē-tōl'ō-jī* [Gr. *herpetōn*, a creeping thing, a reptile; *logos*, discourse]: that branch of natural science which treats of the structure, habits, and history of reptiles; also spelled HERPETOLOGY.

ERR, v. *ěr* [F. *errer*, to wander—from L. *errāre*, to wander: Ger. *irren*, to wander, to go astray: Fin. *eri*, separate, apart; *ero*, departure: Lap. *erit*, away, to another place: connected with Skr. root, *ar*, to plow]: to wander or stray

ERRAND—ERRATUM.

from the right way; to deviate from the line or path of duty; to miss the right way; to commit-error. ER'RING, imp.: ADJ. uncertain; wandering from the truth or the right way. ER'RINGLY, ad. -li. ERRED, pp. *erd*.

ERRAND, n. ēr'rānd [AS. *ærend*, an errand: Icel. *eyrendi*; Sw. *ærende*, a message]: a message; something to be told or done by a messenger.

ERRANT, a. ēr'rānt [OF. *errant*—from L. *erran'tem*, wandering—from *erro*, I wander]: wandering; rambling. ER'RANTRY, n. -tri, the employment of a knight who wandered about seeking adventures; a wandering. KNIGHTS-ERRANT, knights wandering about in search of adventure.

ERRANTIA, n. ēr'rān'shi-a, or ERRAN'TES, n. -tēz [the first form is the neut., the second the masc. and fem. plu. of L. *errans*, pp. of *erro*, I err, I wander: named in allusion to their good locomotive powers]: in zool., errant annelids; the highest order of *Annelida*. They are called also *Chætopoda*, from the setigerous foot-tubercles which are their chief distinctive characteristics; *Nereides*, from their typical genus, *Nereis*; and, from the place which many of them inhabit, Sandworms. The head is well marked; the mouth has jaws which are sometimes at the extremity of a proboscis. The respiratory organs are in the form of external branchiæ arranged in tufts along the back and sides of the body, whence they are called Dorsibranchiate Annelids. They possess distinct sexes, and undergo a metamorphosis. They are marine, and occur in all seas. The order contains the families *Arenicolidae*, *Aphroditidae*, *Nereidæ*, *Eunicidæ*, *Peripatidæ*, and *Polyopthalmidæ*: in paleon., the bodies of the Errant Annelids are as a rule so soft that remains of them are not likely to be found, but what appear to be their horny jaws have been brought from the Silurian, the Devonian, and the Carboniferous formations. What may be their burrows, trails, and foot-impressions or prints have been found in the Silurian and some other Paleozoic rocks.

ERRATIC, a. ēr-rāt'ik [L. *erraticus*, wandering to and fro—from *erro*, I wander: F. *erratique*]: having no fixed course; irregular; strange; queer; in med., showing or having a tendency to spread; also ERRAT'ICAL, a. -i-kāl. ERRAT'ICALLY, ad. -li. ERRATICS, n. plu. ēr-rāt'iks, or ERRATIC BLOCKS, in geol., those large water-worn blocks of stone, commonly called bowlders, scattered plentifully over the higher and middle latitudes of the n. hemisphere; so called because generally they have been derived from rocks at a distance: see BOWLDERS: BÓWLER-CLAY.

ERRATUM, n. ēr-rā'tūm,ERRA'TA, n. plu. [L.]: error or mistake in writing or printing: the list of terrors with their corrections sometimes placed at the end of a book. From greater carefulness in correcting the sheets of a work in passing through the press, errors in sense or typography are now much more rare than formerly; in many instances, indeed, books (not of great size) are now produced without a single error which needs to be pointed out and corrected. As au

ERRHINE—ERROR.

example of an erratum, for ‘terrors’ read ‘errors’ in the first sentence of this article. On this subject interesting particulars are given in Disraeli’s *Curiosities of Literature*, of which the following is a specimen: ‘Besides the ordinary *errata* which happen in printing a work, others have been purposely committed, that the *errata* may contain what is not permitted to appear in the body of the work. Wherever the Inquisition had any power, particularly at Rome, it was not allowed to employ the word *fatum*, or *fata*, in any book. An author, desirous of using the latter word, adroitly invented this scheme: he had printed in his book *facta*, and in the *errata* he put, “For *facta*, read *fata*. ”’

ERRHINE, a. ēr'rīn [Gr. *errhīnōn*, a medicine for inciting sneezing—from *en*, in, and *rhin*, the nose]: in *med.*, affecting the nose; producing discharge from the nose: N. medicines administered locally to produce sneezing and discharge from the nostrils in catarrh, and in various disorders of the head and eyes. Common snuff, and various other vegetable irritants in powder are used.

ERRONEOUS, a. ēr-rō'nē-ūs [mid. L. *errōnēus*, wandering about—from *erro*, I wander]: not conformable to truth; wrong; false; mistaken. **ERRO'NEOUSLY**, ad. -lī. **ERRO'NEOUSNESS**, n. the state of being erroneous or false. **ERROR**, n. ēr'ēr [F. *erreur*—from L. *errōrem*, a wandering, an error]: a deviation from truth; a sin or transgression; involuntary wandering from the truth; a blunder; a mistake; in *law*, a writ so called, which carries the suit for redress to another court (see **ERROR, PROCEEDINGS IN**). **ER'RORIST**, n. -ēr-ist, one who encourages and propagates error.

ERROR, PROCEEDINGS IN: form by which the unsuccessful party in an action at law brings his case for consideration before a court of review. (See **EXCHEQUER, COURT OF: BILL OF EXCEPTIONS**.) Error in law, signifies a mistake of judgment, either as to law or fact. Relief may be had against errors of fact in civil and criminal cases, but not against errors of law, since everyone is presumed to know the law. A mistake made in the trial or decision of a case, prejudicial to the party raising the question also is denominated error, and may constitute a ground for reversing the judgment. Error is also synonymous with writ of error. **WRIT OF ERROR**, common law method of reviewing legal proceedings and decisions. It consisted originally in England of a commission issuing out of the court of chancery to judges, authorizing them to examine the record upon which a judgment claimed to be erroneous, had been rendered, and on the examination thereof, to affirm or reverse such judgment, as the law might require. The writ was grantable as a matter of right in all cases, except treason and felony. If the errors complained of were in matters of fact, the writ was styled *coram nobis* where the case was in the court of queen’s bench, the sovereign being presumed to preside in that tribunal; if in the other courts the writ was *coram vobis*. Writ of error is abolished in England, Appeal being substituted in its stead. In the United States the writ was

ERRORS—ERSCH.

usually issued out of the appellate court in which the review was sought. Some of the states have abolished writs of error, substituting direct appeals, in civil and criminal cases, while in some jurisdictions both writ of error and appeals are retained. See APPEAL, in Law.

ERRORS: mistakes, liable to occur in all observations. The best instruments have imperfections; and no man, however equable his temperament, can always rely on his making a proper use of his senses. In astronomy numerical correctness in the results of instrumental measurements is of the first consequence; therefore it is the constant care of the observer to detect and make allowance for errors. The three principal sources from which they may arise are—1st, External or incidental causes, such as fluctuations of weather, which disturb the amount of refraction; changes of temperature, affecting the form and position of instruments, etc.; 2d, *Errors of observation*, being such as arise from inexpertness, defective vision, slowness in seizing the exact instant of an occurrence, atmospheric indistinctness, etc.; and such errors as arise from slips in clamping and momentary derangements of the instrument; 3d, Instrumental defects, owing to errors in workmanship, and such as arise from the instrument not being properly placed—called errors of adjustment. The first two classes of errors, so far as they cannot be reduced to known laws, vitiate the results of observations to their full extent; but being accidental, they necessarily sometimes diminish and sometimes increase in number and effect. Hence, by taking numerous observations under varied circumstances, and by taking the *mean* or *average* of the results obtained, these errors may be made to destroy one another to a great extent, and so far may be subdued. The method of subduing errors of the first two classes by the law of average is not applicable in all cases. In certain cases, recourse must be had to what is known as the method of least squares. See SQUARES, METHOD OF LEAST: also PROBABILITY. With regard to the third class, it is the peculiarity of astronomical observations to be the ultimate means of detection of all defects of workmanship and adjustment in instruments, which by their minuteness elude every other mode of detection. See Sir John Herschel's *Outlines of Astronomy*, § 138 et seq.

ERS, n. *ers* [L. *ervum*]: in bot., *Ervum Ervilia*, the Bitter Vetch.

ERSBYITE, n. *erz'bī-it* [Sw. *ersbyit*]: in min., a doubtful mineral, called also anhydrous scolecite. It is monoclinic, of a white color and vitreous lustre, and a hardness of six. Dana thinks that it may be altered orthoclase.

ERSCH, JOHANN SAMUEL: 1766, June 23—1828, Jan. 16; b. Grossglogau, in Lower Silesia: founder of German bibliography. He had from an early period a bias toward that branch of literature in which he obtained so high a reputation. At Halle, where he was sent to study theology, 1785, he applied himself to historical investigations. After several vicissitudes, he obtained, 1800, the office of librarian to the Univ. of Jena. Three years later, he was called to Halle

ERSE—ERSKINE.

as prof. of geography and statistics; and in 1808, was appointed in addition, principal librarian. He died at Halle. E. was long engaged in miscellaneous bibliographical work for other scholars; but in 1818, with Gruber, commenced the publication at Leipsic of the *Allgemeine Encyclopädie der Wissenschaften und Künste* (Universal Encyclopædia of the Sciences and Arts), a work of immense value. By his *Handbuch der Deutschen Literatur seit der Mitte des 18 Jahrh. bis auf die Neuste Zeit* (Handbook of German Literature from the Middle of the 18th C. to the most Recent Time, 4 vols. 1812–14), he first established modern German bibliography in the technical sense.

ERSE, n. *érs* [contr. from *Irish*] name given by the Lowland people of Scotland to the branch of the Celtic language spoken by the inhabitants of the Western Highlands, as being of Irish origin: see BRETTs AND SCOTS. The proper name is Gaelic (q.v.).

ERSEK'-UJVAR': see NEUHAUSEL.

ERSKINE, *érs'kīn*, EBENEZER: founder of the Secession Church in Scotland: 1680, June 22—1756, June 22; son of the Rev. Henry Erskine, minister of Chirnside, in Berwickshire, descendant of the noble family of Mar. He studied at Edinburgh, and after acting for some time as tutor and chaplain in the family of the Earl of Rothes, he was licensed to preach by the presbytery of Kirkcaldy 1702. In the following year he was appointed minister of Portmoak, in the shire of Kinross. Here he applied himself indefatigably to the study of the Scriptures, and to a serious and earnest preaching which became exceedingly attractive to the people accustomed to the chilling 'legalism' which then predominated in the Scottish pulpit. On 'sacramental occasions,' he had frequently attendants from the distance of 60 or 70 miles. In 1731, he was transferred to Stirling; his religious peculiarities had brought him into unpleasant relations with some of his brethren, through the interest which he exhibited in a book called the *Marrow of Modern Divinity*, marked by its strong evangelicalism of doctrine and sentiment. After his transference to Stirling, E. distinguished himself by his advocacy of popular rights in the settlement of ministers; and ultimately involved himself in such antagonism to the Church of Scotland, or at least to the ruling party in it of the time, that, with other three clergymen, he was deposed 1733: see UNITED PRESBYTERIAN CHURCH. He was shortly afterward joined by his brother Ralph and several other ministers. They now virtually formed a distinct sect, but continued to occupy their parish churches. An effort was made, 1734, to restore them to their legal connection with the church; it was unsuccessful. In 1736, E. and his friends formally seceded, but it was not till 1740 that they were ejected from their churches. Shortly after this, a furious, and, as it now seems, a contemptible squabble broke out among the seceders in regard to the propriety of taking the burgess-oath. The result was a division of the sect into two bodies, the Burghers and Antiburghers. E. was the leader of the Burghers.

ERSKINE.

ERSKINE, JOHN, of Carnock, afterward of Cardross: eminent Scottish jurist, and prof. of Scots law in the Univ. of Edinburgh: 1695—1768; son of the Hon. John E. of Carnock, third son of Lord Cardross, whose descendants have now succeeded to the earldom of Buchan. John E., the father, having been forced to quit Scotland, from his attachment to the Presbyterian religion, retired to Holland, and became an officer in the service of the Prince of Orange. At the Revolution, he accompanied William to England, and, as a reward for the services, was appointed lieut.gov. of Stirling Castle, and lieut.col. of a regt. of foot. John E., the younger, became a member of the Faculty of Advocates 1719, but did not succeed as a practitioner of the law. On the death of Alexander Bain, 1737, E. succeeded him in the chair of Scots Law, and filled that office 28 years. In 1754 he published his well-known *Principles of the Law of Scotland*, the text-book thenceforth used in legal study. On his retirement from the professorship in 1765, he prepared his more important work, *The Institutes of the Law of Scotland*, not published till five years after his death. Mr. E. was twice married: one of his sons was the Rev. Dr. John E. As a legal writer, Mr. E. is inferior to none of the Scottish jurists, with the exception of Lord Stair, who dealt more with the principles of commercial law as known to our time. But of all those departments—such as feudal conveyancing—which constitute the law of Scotland, as developed by the usages and forms of society in the country itself, there is at the present day no clearer or more trustworthy expositor than Erskine.

ERSKINE, JOHN, D.D.: 1721, June 2—1803, Jan. 19; son of John E. of Carnock (author of *Institutes of the Law of Scotland*). He studied at the Univ. of Edinburgh, and was licensed to preach by the presbytery of Dunblane, 1743. In the following year, he was ordained minister of Kirkintilloch, where he remained until 1753, when he was presented to the parish of Culross, in the presbytery of Dunfermline. In 1758, he was transferred to New Greyfriars Church, Edinburgh; and in 1767, he was promoted to the collegiate charge of Old Greyfriars, where he had for his colleague Dr. Robertson. In the General Assembly of the Church of Scotland, he was for many years the honored leader of the popular or evangelical party. Between him and Principal Robertson, leader of the moderate party, there was an honorable friendship. E.'s writings are exceedingly numerous. They consist of essays, letters, sermons, dissertations, and pamphlets, etc., mainly religious. Sir Walter Scott, in his *Guy Mannering*, gives a graphic and accurate description of his powers as a preacher.

ERSKINE, RALPH: 1685, Mar. 18—1752, Nov. 6; b. Monilaws, Northumberland; brother of Ebenezer E. He was ordained to the parish church of Dunfermline 1711. Sympathizing with the sentiments of his brother Ebenezer, he withdrew from the judicatures of the Established Church 1737. In the controversy concerning the burgess-oath he took part with his brother. His fame rests chiefly

ERSKINE.

on his *Gospel Sonnets* and other religious works, formerly very popular.

ERS'KINE, THOMAS, Lord ERSKINE: 1750, Jan. 10—1823, Nov. 17; b. Edinburgh; youngest son of Henry David, tenth earl of Buchan, who though then reduced to an income of £200 a year, was of a race prolific in men of ability, and ennobled before the era of genuine history. After E. had attended for some time the High School of Edinburgh, the family removed to St. Andrews, at the grammar school of which place, and subsequently at the university, though probably not as a matriculated student, Thomas E. received such education as his parents could afford. They were educating his second brother, Henry, for the Scottish bar: (Henry, afterward the famous Harry Erskine, twice lord advocate of Scotland and a noted wit; 1746, Nov. 1—1817, Oct. 8: for the family history, see Col. Fergusson's *Henry Erskine: His Kinsfolk and Times*, 1882). The parents sent E. to sea as a midshipman. In this capacity he served for four years, until the death of his father, when he purchased a commission in the First Royals, and was for some time stationed at Minorca, where he employed his leisure in the study of English literature. On his return to London, his birth, his acquirements, the elegance of his manners, and volubility of his conversation, procured him a warm reception in the best circles. It was then that he had the controversy with Dr. Johnson on the respective merits of Fielding and Richardson, which Boswell has recorded; and that he published a pamphlet on the prevailing abuses in the army, which, though anonymous, was well known to be his, and obtained a great circulation. E. grew tired of the army as a profession, in which he saw little chance of promotion; and while in this humor, an accidental interview with Lord Mansfield at an assize court, determined him to study law. He was admitted a student of Lincoln's Inn, 1775, Apr. 26; and 1776, Jan. 13, he entered his name on the books of Trinity College, Cambridge, as a gentleman commoner. Many anecdotes are told of the privations which E. underwent when studying for the bar—how he lived on ‘cow-heel and tripe,’ dressed so shabbily as to be quite remarkable, and boasted that *out of his own family* he did not know a lord. Lord Campbell says, that ‘during Easter and Trinity terms he excited a great sensation in the dining-hall by appearing in a student’s black gown over the scarlet regimentals of the Royals; *probably not having a decent suit of plain clothes to put on.*’ Though E. was aided by his aristocratic connection, his rise was very wonderful. Without the advantage of a business training, or what, probably even in those days, was far more important, a business connection, he rose into practice with almost unprecedented rapidity. After his first speech, the attorneys actually flocked round him with their retainers, and in telling the story, he used sometimes to bring the number which he received before quitting Westminster Hall up to sixty-five! His two first clients were officers in the navy—Captain Baillie, who held an office in Greenwich Hospital, against whom a rule had been obtained calling upon him to show

ERSMERT—ERUCA.

cause why a criminal information for a libel reflecting on Lord Sandwich's conduct as gov. of the charity, should not be filed upon him; and Admiral Keppel, who was tried by a court-martial at Portsmouth for incapacity and misconduct in an encounter with the French fleet off Ushant; and in both cases E. derived benefit from his own early connection with the service. Admiral Keppel sent him two £500 notes as a fee. From this time, E.'s good fortune as an advocate was uninterrupted. In 1783, he was returned to parliament for Portsmouth. Four years and a half after he was called to the bar, he had cleared £8,000 to £9,000, besides paying his debts, he had his silk gown, business of at least £3,000 a year, and a seat in parliament, and had made his brother lord advocate. In parliament, on the other hand, he failed so egregiously in his first speech as to leave his admirers scarcely any hope, and what is remarkable, his failure and Lord Eldon's took place the same night. To some extent the phenomenon was accounted for by Sheridan's remark when he said to him: 'Erskine, you are afraid of Pitt, and that is the flabby part of your character.' But notwithstanding his political mortifications, his professional career went on with increasing brilliancy. In 1786, he was made attorney-gen. to the Prince of Wales, by whom he was warmly patronized, but toward him and every one else he exhibited that manly independence which was the best part of his character. The fact of his appearing as counsel for Thomas Paine may be counted to his credit, while his removal in consequence from his office was declared by Lord Campbell a lasting disgrace to those from whom the measure proceeded. Throughout the political trials at that troubled period, he enacted the same manly part. When E. was proposed for the woolsack, an office far beyond his legal attainments, the king, George III., in consenting exclaimed: 'What! what! well! well!—but remember he is your chancellor, not mine.' Yet his decisions as lord-chancellor, according to Lord Campbell, are not so much *bad* as *superficial*, though by some equity practitioners they are spoken of as the *Apocrypha*. E. was engaged in the defense of Queen Caroline.

ERSMERT, n. *érs'mért*: the plant *Polygonum Hydro-piper*; called also smart-weed.

ERST, ad. *érst*: see under ERE. ERST-WHILE, till then; till now; formerly.

ERSWORT, n. *ers'wert*: the herb mouse-ear (*Hieracium Pilosella*).

ERUBESCENT, a. *ér'ú-běs'ěnt* [L. *erüběscěn'tem*, growing red—from *e*, out of; *rüběr*, red]: reddish; flushing. ER'UBES'CENCE, n. -ěns, redness of the skin or surface of anything. ER'UBES'CITE, n. -běs'it, purple copper ore—a sulphide of copper and iron.

ERUCA, n. *ē-ró'ka* [L. a caterpillar]: insect in the larval state; a caterpillar.—E. is also a genus of plants of the ord. *Cruciferae*, family *Brassicidae*. The seeds have a burning taste, and applied to the skin cause blisters. *Eruca sativa*,

ERUCARIDÆ—ERVUM.

formerly called *Brassica eruca*, is used in the south of Europe, its native region, as a salad, the young and tender roots alone being chosen. The whole plant has been used as a sialagogue.

ERUCARIDÆ, n. ēr-ō-kăr'ī-dē [mod. L. *erucaria*]: a family of crucifers, tribe *Spirolobæ*, of which *Erucaria* is the type.

ERUCIC ACID, ēr-ū'sik- [L. *erūcā*, a species of cole-wort]: an organic body of the oleic acid series, obtained from oil of mustard and rape-seed.

ERUCTATE, v. ē-rük'tāt [L. *eructātūs*, belched out—from *e*, out of; *ructātus*, belched: It. *eruttare*: F. *érupter*]: to throw up foul air from the stomach; to belch. ERUC-TATING, imp. ERUC-TATED, pp. ERUCTATION, n. ē'rük-tāshūn [F.—L.]: the act of belching wind or foul air from the stomach; the wind itself; a belch; a violent bursting forth of gaseous and liquid matter from any orifice or opening, as from the crater of a volcano or geyser.

ERUDITE, a. ēr'ū-dīt [L. *erūdītus*, free from rudeness, cultivated—from *e*, out of; *rūdis*, rough: It. *erudito*: F. *érudit*—lit., free from rudeness and ignorance]: instructed; conversant with books; learned. ERUDITION, n. -dish'ūn [F.—L.]: knowledge gained by study of books; learning in literature; scholarship. ERUDITELY, ad. -dit-lī.—SYN. of ‘erudition’: learning; knowledge; science; literature; letters.

ERUGINOUS, a. ē-rōj'i-nūs [sec AERUGINOUS]: resembling the rust of copper or brass.

ERUMPENT, a. ē-rūm'pēnt [L. *e*, out of; *rumpēn'tem*, breaking]: in bot., prominent, as if bursting through the epidermis, as in some tetraspores.

ERUPTED, a. ē-rūpt'ēd [L. *erūptus*, broken out or burst forth—from *e*, out of; *ruptus*, rent asunder]: forcibly thrown out, as from a volcano. ERUPTION, n. -shūn [F.—L.]: a bursting out from confinement; a violent throwing out of anything, as flames or lava from a volcano; a sudden and overwhelming hostile rush of armed men from one country to another; a breaking out of pustules or pocks on the skin, as in measles, small-pox, etc. ERUP-TIVE, a. -tīv, bursting forth; attended with eruptions or producing them; in geol., applied to igneous rocks, which have evidently burst through the sedimentary strata.

ERVALENTA, n. ēr-va lēn'ta [L. *Ervum lens*, botanical name of the lentil]: farina or meal of the common lentil, prepared in a special manner. Its use as a food is said to promote the peristaltic action of the bowels.

ERVILIA, n. ēr-rīl'i-a [L. *ervilia*, the bitter vetch]: in zool., lentil-shell; a genus of bivalve mollusks, family *Tellinidæ*. Two recent species are known. Distribution: W. Indies, Britain, Canaries, Mediterranean, and the Red Sea.

ERVUM, n. ēr'vūm [L., the bitter vetch, *Ervum Ervilia*]: in bot., genus of papilionaceous plants, tribe *Vicieæ*. *Ervum lens* is the lentil. *Ervum Ervilia* is the bitter vetch. Its

ERYCIBEÆ—ERYINGO.

seeds mixed with flour and made into bread produce weakness of the limbs, and render horses paralytic.

ERYCIBEÆ, n. ēr-i-sib'ē-ē [mod. L. *erycibe*]: in bot., order of plants established by Endlicher for the reception of the genus *Erycibe*, by some others doubtfully ranked at the end of *Convolvulaceæ*. It is from tropical Asia.

ERYCINA, n. ēr-i-sī'na [*Erycina*, name of Venus—from Mount Eryx, now San Giuliano, mountain in Sicily, where she had a temple]: in entom., genus of butterflies, typical of the family *Erycinidæ*. ERYCINIDÆ, n. ēr-i-sīn'i-dē, dryads; family of butterflies. The males have only four perfect legs, the females have six. In other respects they resemble the *Lycenidæ* (Argus Butterflies).

ERYINGO, n. ēr-īng'-gō [L. *eryngion*, a species of thistle], (*Eryngium*): genus of plants of the nat. ord. *Umbelliferæ*, having simple umbels, which resemble the heads of composite flowers, a leafy involucre and leafy calyx, and obovate, scaly fruit destitute of both ridges and vittæ. The species are numerous, mostly natives of the warmer temperate parts of the world, with alternate, simple, or divided leaves, which have marginal spines. The SEA ERYINGO (sometimes ERYNGO), or SEA HOLLY (*E. maritimum*), is frequent on sandy sea-shores of Britain; a very stiff, rigid, and glaucous plant. *E. campestre* also has been found in England and Ireland, but is very rare. Its root was formerly much used in some parts of Europe as a tonic. That of *E. maritimum* is used in the same way, and possesses the same properties, being sweet and aromatic. It is sold in a candied state, and was formerly reputed stimulant, restor-



Sea Holly (*Eryngium maritimum*):

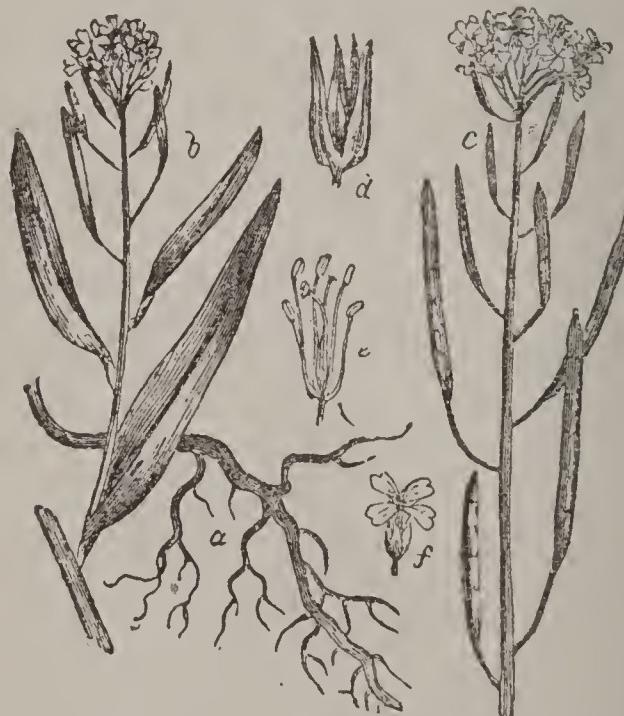
a, a stamen; *b*, a petal; *c*, a pistil;

native, and aphrodisiac. Shakespeare makes Falstaff allude to the snowy color and supposed properties of this now

ERYSUMUM—ERYSIPelas.

almost disused sweetmeat, for the preparation of which Colchester, England, has long been famous. E. root has been used also as an aperient and diuretic. Linnæus recommends the blanched shoots of *E. maritimum* as a substitute for asparagus. *E. fetidum*, native of the warm parts of America, is called Fit-weed in the W. Indies, a decoction of it being much used as a remedy in hysterical cases. *E. aquaticum*, native of low wet places in N. and S. America, is called Rattlesnake Weed and Button Snakeroot. The root is diaphoretic and expectorant, and has a spurious reputation as a cure for the bite of the rattlesnake.

ERYSUMUM, ē-rīs'ī-mūm: genus of plants of the nat. ord. *Cruciferae*, tribe *Sisymbrieæ*. The pod is four-sided. *E. cheiranthoides*, a branching annual, about 18 inches high, with lanceolate scarcely toothed leaves and small yellow flowers, is found in many parts of Europe, also in N. America. It is common in waste places and cultivated grounds in Britain, but may perhaps have been originally intro-



Erysimum Cheiranthoides:

a, root; b, a branch, in which flowering has recently begun; c, the summit of a branch in a more advanced state, showing the fruit; d, the calyx; e, the parts of fructification, divested of floral envelopes; f, a flower.

duced for its medicinal use. Its seeds were formerly much used as an anthelmintic, from which it has the name of WORM-SEED. It is called also TREACLE MUSTARD, because it was an ingredient in the famous *Venice Treacle*. *E. perfoliatum* is cultivated in Japan for the fixed oil of its seeds. Some of the plants formerly referred to E. are now included in other genera, as *Sisymbrium* and *Alliaria* (q.v.).

ERYSIPelas, n. ēr'ī-sip'ē-lās [L. *erysipēlas*—from Gr. *erūsip'ēlas*, a red eruption on the skin—from *erūthrōs*, red; *pella*, skin]: an eruption of a fiery inflammatory nature ou

ERYSIPHE—ERYTHEMA.

some part of the body; the disease called St. Anthony's fire; the rose. ERYSIPELATOUS, a. ēr'i-si-pēl'ā-tūs, eruptive; of or resembling erysipelas.—*Erysipelas* is an inflammatory and febrile disease of the skin, attended by diffused redness and swelling of the part affected, and in the end either by desquamation or by vesication of the cuticle or scarf-skin, in the milder forms, and by suppuration of the deeper parts in the severer varieties (phlegmonous erysipelas). Erysipelas affects, in a large proportion of instances, the face and head; it is apt to be attended with severe and typhoid fever (see FEVER), and often with great disorder of the nervous system, arising in some instances from inflammation of the membranes of the brain. In other parts of the body, severe or phlegmonous erysipelas is apt to be succeeded by protracted and exhausting suppurations, and sometimes by diseases of the bones, or inflammations of the internal organs. Erysipelas is frequently an epidemic (q.v.) disease; it is also very apt to recur in a person who has been attacked once or oftener; and this is especially true of the form which affects the face. It is seldom that depletion is allowable in erysipelas, but the bowels should be well cleared out in most cases, and a diuretic (q.v.) given, after which the treatment consists for the most part in watching narrowly the progress of the case, keeping up the strength as well as possible, and obviating special dangers as they occur. In some cases, iron is used as a specific remedy.

ERYSIPHE, n. ēr-iš'i-fē [Gr. *erūsibē*, mildew]: in bot., old genus of fungi now much reduced in extent by the removal from it of various species now ranked under distinct genera. When undeveloped they are called Oidia.

ERYTHACUS, n. ē-rīth'a-kūs [Gr. *eruthainō*, I dye red, I cause to blush, in allusion to the red plumage of the Robin Redbreast, a species of the genus]: typical genus of *Erythacinae*, sub-family of warblers, of the e. hemisphere. The American robin, a thrush, was misnamed by colonists.

ERYTHEMA, n. ēr'i-thē'mā [Gr. *erūthēmā*, redness—from *erūthainō*, I make red]: in med., a superficial redness of the skin; minor form of erysipelas (q.v.), presenting the same tendency to diffusion and redness, but not so much swelling, and little disposition toward suppuration, or even vesication. It is dangerous chiefly when it presents itself in a wandering shape, attended with slow consuming fever. The muriated tincture of iron, in doses of 20 drops in water every hour or two, has been regarded as a specific in this disease, as well as in erysipelas. Some forms of erythema are distinctly connected with constitutional diseases, as gout, rheumatism, syphilis, etc., and depend for their cure on the removal of the cause. ER'YTHEM'ATOUS, a. -thēm'ā-tūs, pertaining to. ER'YTHEMAT'IC, a. -māt'ik, a term applied to skin affections marked by or associated with redness, specially relating to erythema, erysipelas, and the more common rose-rash and nettle-rash. ER'YTHRINE, n. -thrīn [Ger. *erūthros*, red]: a mineral of a carmine and peach-blossom red color; arseniate of cobalt, or

ERYTHRÆA—ERYTHRORCHIS.

cobalt-bloom, used for the manufacture of smalt. **ERYTHRINE**, n. *ĕr'i-thrīn*, a very complex aromatic body found in certain lichens; also called **ERYTHRIC ACID**. **ER'YTHRITE**, n. *-thrīt*, a mineral, a flesh-colored variety of felspar; & tetravalent alcohol obtained as a solid white substance from certain lichens and fungi.

ERYTHRÆA: see CENTAURY.

ERYTHRÆAN SEA: in *anc. geog.* the Persian and Arabian gulfs, and a further undefined portion of the Indian Ocean. Later, the name denoted the Arabian Gulf.

ERYTHRINA: see CORAL FLOWER.

ERYTHROLITMIN, n. *ĕ-rīth-ro-līt'mīn*: in *chem.*, $C_{26}H_{23}O_{13}$: red coloring matter extracted by Kane from litmus.

ERYTHRONIUM; *ĕr-i-thrō'nī-ūm*: genus of bulbous rooted plants of the nat. ord. *Liliaceæ*, with drooping flowers and the segments of the perianth reflexed. *E. dens-canis*, the DOG-TOOTH VIOLET, belongs to cent. Europe and s. Siberia; cultivated. The YELLOW ADDER'S TONGUE (*E. Americanum*) of the U. S. is a familiar yellow flower in May, with mottled lily-like leaves; bulbs emetic. The WHITE DOG-TOOTH VIOLET, leaves little or not spotted, has a yellow variety near Lake Superior.

ERYTHROPHLÆUM, *ĕ-rīth-rō-flē'ūm*: genus of trees of the nat. ord. *Leguminosæ*, sub-order *Mimoseæ*. *E. Guineense*, native of Guinea, is a very large tree, 100 ft. high, remarkable for the great quantity of red juice which every part of it contains, and interesting on account of the employment of this juice by the natives for an ordeal to test the innocence or guilt of a person accused of crime. The juice is swallowed in large draughts, and those who remain uninjured by it are supposed to be innocent.

ERYTHROPHLEINE, n. *ĕ-rīth-ro-fliē'in* [mod. L. *erythrophlaeum*]: in *chem.*, poisonous base, extracted by alcohol from the bark of *Erythrophlaeum guineense*, a tall leguminous tree, on the w. coast of Africa. It is only slightly soluble in ether, benzine, or chloroform, but is soluble in water and in alcohol. It forms salts with acids. In contact with manganese peroxide and sulphuric acid, erythrophleine develops a violet color less intense than that produced by strychnine; the color soon changes to a dirty brown. It acts as a poison by paralyzing the action of the heart.

ERYTHROPHYLL, n. *ĕ-rīth'rō-fil* [Gr. *erūthrōs*, red; *phullon*, a leaf]: the red coloring matter of leaves, indicating change and low vitality in them.

ERYTHROPROTIDE, n. *ĕ-rīth-ro-prō'tid* [Gr. *eruthros*, red; *prōtos*, first]: in *chem.*, red extractive matter obtained by Mulder from albumen and allied substances.

ERYTHRORCHIS, n. *ĕ-rīth'rōr-kīs* [pref. *erythro*; Eng. *orchis*]: in *bct.*, genus of orchids, tribe *Arethuseæ*, family *Vanillidæ*. *Erythrorchis scandens* has slender stems a hundred ft. long, and runs like a creeper over trees in wet jungles in the Eastern peninsula and the adjacent islands.

ERYTHROSIS—ERZERUM.

ERYTHROSIS, n. ē-ri-thrō'sis [Gr. *eruthros*, red]: see PLETHORA.

ERYTHROSPERMÆ, n. ē-ri-th-ro-spér'mē-ē [mod. L. *erythrospermum*]: in bot., tribe of *Flacourtiaceæ*. The styles are several, the fruit ultimately splits. ERYTHROSPERMUM, n. -mūm [Gr. *eruthros*, red; *sperma*, seed]: typical genus of the tribe *Erythrospermæ*.

ERTYHROXYLACEÆ, ēr-īth-rōks-īl-ā'sē-ē: nat. ord. of exogenous plants, allied to *Malpighiaceæ*. They are trees or shrubs, with alternate simple leaves, stipules, flowers growing from amid scale-like bracts, calyx of five sepals, corolla of five petals, each petal having a curious appendage—a plaited scale—at the base, ten stamens united at the base, a 3-celled ovary with two cells empty, and the third containing a single ovule, three styles, and the fruit a drupe. Nearly 100 species are known, natives of warm countries, chiefly of tropical America. To this order belongs the Coca (q. v.). The wood of some of the species is bright red; that of *Erythroxylon* (Gr. red wood) *suberosum* is used in Brazil for dyeing, and a permanent red is obtained from it. That of *E. hypericifolium* is the *Bois d'huile* (Oil-wood) of Mauritius.

ERYTHROZYME, n. ē-ri-th'rō-zīm [Gr. *erūthros*, red; *zumē*, leaven]: in chem., azotized substance, which exists in madder, and gives rise to a peculiar transformation of rubian. It is extracted by macerating madder in water at 38°, and precipitating the aqueous extract with alcohol.

ERYX, or ERIX, n. ēr'iks [L. *Eryx*, an opponent of Hercules, who slew him and buried him on a mountain, which retained his name. Various other classic men or myths]: in zool., genus of snakes, family *Boidæ*. They are small in size, and have not the prehensile tail of the huge boas and pythons. They are found in India and the Eastern islands, and in Turkey, Greece, and Egypt.

ERZ'BERG: see EISENERZ.

ERZERUM, or ERZROUM, or ERZRUM, ērz-rōm': province of Asiatic Turkey, in Armenia; bounded by Trebizonde, Karpoot, Diarbekir, Van, Persia, and Transcaucasia; contains the sources of the Euphrates, Araxes, Koor, and Choruk rivers, and several chains of mountains, inhabited chiefly by Kurds; has a general elevation of 6,000 ft., and produces large quantities of fruits, rye, barley, flag, and grasses for sheep and cattle. Cap. and largest city in Armenia, E.—Pop. of province 597,000.

ERZERUM, ēr-zē-rōm', or ERZROUM, ērz-rōm', properly *Erserum*: strongly fortified town in Turkish Armenia, lat. 39° 55' n., long. 41° 20' e., not far from the n. source of the Euphrates. It is in a high, moderately well cultivated plain; 6,200 ft. above the sea. The climate is cold in winter, but dry in summer. E. is the residence of an English, a Russian, and a French consul; and its people carry on a brisk trade, and have attained a prosperity unusual in the East. The copper and iron wares of E. have wide celebrity. Situated at the junction of the important highways leading

ERZGEBIRGE.

from Trebizond, Transcaucasia, Persia, Kurdistan, Mesopotamia, and Anatolia, E. forms an entrepôt of commerce between Europe on one hand, and the interior of Asia, and particularly Persia, on the other. The streets, the houses of which are chiefly of volcanic stone cemented with mud, are narrow, crooked, and filthy; and ruins of fortifications and of buildings formerly magnificent, everywhere meet the eye. The town consists of the fortress, strictly so called, and four suburbs. The fortress, inclosed by a high wall, has, on the w., a citadel called Ijkaleh, with many curious monuments, and a mosque of Christian origin. The fortress also contains 15 mosques, the residence of the chief magistrate, some caravanseras, and a few elegant houses belonging to the higher order of officials and Mohammedan merchants. The suburbs have 24 mosques, several Armenian churches, and a number of large bazaars and caravanseras. E. imports shawls, silk goods, cotton, tobacco, rice, indigo, etc.; and exports corn, sheep, and cattle, horses, mules, and gall-nuts. The principal trades carried on are tanning, dyeing morocco, and blacksmiths' and coppersmiths' work. But since Russian Transcaucasia has provided a safe trade-route to Persia, the prosperity of E. has greatly suffered. E. is a very ancient town. Its Armenian name was *Garin Khalakh*. Near it stood the old Syro-Armenian town of Arsen. When the Seljuks captured this place, the inhabitants fled to a fortress at E., which the Seljuks accordingly called *Arsen-er-Rum*, i.e., Arsen of the Romans (or Byzantines), whence the modern Erzerum. In 1201 it fell into the hands of the Seljuks; of the Mongols 1242; and, finally, 1517, into those of the Turks. It however continued the most important city in the country, and at the commencement of the 19th c. had a pop. of 100,000. In the war of 1829, between the Turks and Russians, the taking of E. by the latter decided the campaign in Asia. E. was an important military centre during the war of 1877-8, and much hard fighting was done in its neighborhood. In 1877, Dec., the Russians closed round the city, already hard pressed, and reduced its defenders to the utmost distress: in 1878, Feb., it was surrendered to Russia. The Russians held it till 1878, Oct., when it was given up to the Turks.—Pop. est. (1870) 40,000 (of which Turks 30,000, Armenians 8,000, Persians 2,000); (1900) 38,900.

ERZGEBIRGE, *ērts-ga-bēr'gēh* ('Ore Mountains'): chain of mountains, rich in metals, stretching s.w. on the confines of Saxony and Bohemia, from the valley of the Elbe to the Fichtelgebirge; long. $12^{\circ} 20'$ e. In the s. it rises 3,000 to 2,500 ft., forming a steep wall of rock; in the w., it forms broad, slaty plateaux, and gradually slopes down toward the Saxon side to the level districts of Altenburg and Leipzic. In consequence of this formation, the streams flowing southward are small, while the n. side of the chain, which is well wooded, presents a series of romantic, and occasionally fertile and thickly peopled valleys, watered by the Mulde, the Pleisse, and their numerous tributaries. The town of Gottesgabe, a site the highest in Germany, is toward the s. of the E. range; long. $12^{\circ} 54'$ e., at an eleva-

ESARHADDON—ESCALADE.

tion of 3,162 ft. The Keilberg, highest point of the range, is 3,802 ft. above the sea. The E. is chiefly of the gneiss-granite formation, in which most of the metal strata are to be found. Porphyry and basalt likewise appear.

ESARHADDON, *ē-sar-hăd'don*, King of Assyria: reigned B.C. 680–668; favorite son and successor of Sennacherib. He ascended the throne after two of his brothers had killed their father. He rebuilt Babylon and made it his southern capital; invaded Egypt, captured Memphis with all its treasures, and made the country as far as Thebes an Assyrian province; secured the n.e. frontier of his empire by an energetic campaign against the Minni and the Medes; penetrated to the heart of Arabia, and reduced a large number of native tribes to subjection; defeated the Cimmerians after checking their southward march, and drove them w. toward Sinope; subdued Cilicia, the Dahæ, and Eden; and was besieging Tyre when he died. He distinguished himself as an organizer and leader of armies; was mild and conciliatory in his civic administration; built or rebuilt vast palaces, fortresses, and temples, especially in Nineveh, Calah (Nimroud), and Babylon; and was succeeded by his son Asurbanipal, or Sardanapalus, whom he had associated with himself in the govt. on his return from the Egyptian campaign.

ESAU, *ē'saw* ('hairy' or 'rough'): eldest son of the patriarch Isaac, and twin-brother of Jacob. As E. grew up, he became 'a man of the field,' a cunning hunter, and his father's favorite. He seems to have been a wild, rough, hearty Bedouin, or son of the desert, thinking nothing of tomorrow, but living with joyous carelessness from day to day. This is apparent from the manner in which he allowed Jacob to defraud him of his birthright, though it carried with it, besides many temporal advantages, the Divine *Covenant-blessing* itself. After this transaction, E., when 40 years of age, married two Canaanitish women, 'which were a grief of mind unto Isaac and to Rebekah (Gen. xxvi. 35). Then follows the narrative of Jacob's personation of his brother, and his securing irrevocably the blessing to himself. E. now swore to kill his brother, whereupon Rebekah sent Jacob to his uncle Laban in Padanaram. E. next married his cousin Mahalath, daughter of Ishmael; and appears to have established himself in his wife's country, s. of Palestine in Mount Seir. Here he lived probably as a predatory chief. When Jacob was returning from Padanaram, E. encountered him with 400 of his Bedouins. The meeting was a touching one. The wild borderer at least was in earnest. 'Esau ran to meet him, and embraced him, and fell on his neck, and kissed him' (Gen. xxxiii. 4). His anger had long died out. E. next appears at the burial of his father Isaac, whom he seems to have loved with the warm and simple affection of a child of nature, and having obtained his share of the property, 'went into the country from the face of his brother Jacob' (Gen. xxxvi. 6). From E. the region of Mount Seir took the name of Edom (q.v.), and his posterity are generally called Edomites.

ESCALADE, n. *ēs'kă-lăd'* [F. *escalade*—from It. *scalata*;

ESCALLONIA—ESCAPE.

Sp. *escalada*, an escalade—from L. *scālā*, a ladder: OF. *scalle*, a ladder]: the entering by troops into a fortified place by means of ladders: it consists in advancing over the glacis and covert-way; descending, if necessary, into the ditch by means of ladders; and ascending to the parapet of the curtain and bastions by the same ladders differently placed. A convenient form of ladders is in pieces of 12 ft. length, fitting end to end by means of sockets. A firing-party is usually told off, to keep down the fire of the enemy upon the escaladers, especially a flank fire lengthwise of the ditch, which might sweep them off with terrible rapidity. The leaders of an escalade constitute a ‘forlorn hope.’ ESCALADE, v. to enter a place by ladders. ES’CALA’DING, imp. ES’CALA’DED, pp.

ESCALLONIA, n. ēs-kal-lō’ni-a [named after *Escallon*, Spanish traveller in S. America, who first found these plants in Guiana]: in bot., typical genus of the order *Escalloniaceæ*. The species are S. American trees or shrubs, with dotted leaves and white, pink, or red whorled leaves.

ESCALLOP, n. ēs-kāl’ōp [see SCALLOP]: a bivalve shell; inequality of margin.

ESCALLOPÉE, a. ēs-kāl’lō-pā [F.]: in her., term applied to an escutcheon, etc., which is covered with curved lines, resembling the outline of a scallop-shell, and overlapping each other.

ESCALLOPED: see ESCALLOPÉE.

ESCANABA: a city and cap. of Delta co., Mich., on the n. end of Green bay, at the mouth of the Escanaba river, and on the Chicago and Northwestern railroad; 360 m. n. of Chicago. It is the vegetable and grain-raising and lumbering center of the county and an important point for the shipping of iron ore, about 4,000,000 tons being exported annually. It also exports coal, lumber, and fish. It has passenger and freight steamer connections with the chief ports on the Great Lakes, public school, public library, daily and weekly newspapers, national bank, and an assessed property valuation of \$2,000,000. Pop. (1890) 6,808; (1900) 9,549.

ESCAPE, v. ēs-kāp' [OF. *eschaper*; F. *échapper*, to shift away, to slip out of: It. *scappare*, to run away: Gael. *sgap*, to scatter, to escape: Icel. *skreppa*, to slip away]: to flee from and avoid; to get out of the way without injury; to shun or evade; to pass without notice; to avoid an evil, as punishment; to shun danger or injury: N. a getting away from danger; flight; excuse; evasion; subterfuge. ESCAPING, imp.: N. avoidance of ‘danger. ESCAPED’, pp. -kāpt. ESCAPER, n. one who. ESCAPEMENT, n. that part of the machinery of a watch or clock by which the onward revolving motion produced by the moving power, whether weights or spring, is brought into contact with the regulating movement of the pendulum or balance-wheel: see HOROLOGY. ESCAPADE, n. ēs’kā-pād' [F.]: a mischievous freak; an impropriety of speech or slip of the tongue; the

ESCAR—ESCHATOLOGY.

gambols of a horse. ESCAPE WARRANT, warrant issued by a judge for the apprehension of persons who have escaped from certain prisons.—SYN. of 'escape v.': to avoid, elude; eschew, flee.

ES'CAR: see ESKAR.

ESCARP, v. *ěs-kárp'* [F. *escarper*, to cut to a slope—from It. *scarpa*, the scarp or slope of a wall]: to form a slope: N. in *fortification*, the side or steep slope of the ditch next the rampart, and of the parapet itself. When the ditch of a fortress is dry, the escarp is usually faced with masonry, to render it difficult of ascent; and behind this facing (*revêtement*) there are often passages or casemates for defense. In temporary fortifications, the *revêtement* is sometimes of wood; and in field-works, palisades at the foot, or *fraises* on the *berme* or edge of the ditch, are deemed sufficient. The escarp is always made at as large an angle as the nature of the soil will allow; the design being to offer the greatest possible obstacle to an assailant. ESCARP'ING, imp. ESCARPED', pp. *-kárpt'*, cut or formed to a sudden slope. ESCARP'MENT, n. *-měnt* [F.]: the steep face of a ridge of high land; ground about a fortified position cut away nearly perpendicularly to prevent the approach of an enemy.

ESCARTEL, v. *ěs-kár'těl* [F. *écarteler*, to quarter]: in her., to cut or notch in a square form, or across.

ESCARTELÉE, a. *ěs-kár'těl-lā* [F.]: cut or notched in a square form, or across.

ESCAUT': see SCHELDT.

ESCHALOT, n. *ěsh'ă-löt'* [F. *échalotte*; OF. *eschalote*—from mid. L. *ăscálōnă*]: an edible bulb related to the onion; the *shalot*; the *Allium ascalon'icum*, ord. *Liliacæ*.

ESCHAR, n. *ěs'kár* [Gr. *eschrāră*, a hearth, a scab: F. *escarre*]: in med., a crust or scab, being a slough or portion of dead or disorganized tissue; usually produced artificially by application of caustics (q.v.). ES'CHAROT'IC, a. *-káröt'ik*, having the power to sear or burn the flesh: N. a powerful caustic: see CAUSTIC.

ESCHARIDÆ, n. *ěs-chăr'i-dē* [L. *eschara*]: in zool., family of polyzoa or bryozoa, sub-order *Cyclostomata*. The cœnœcium is erect and rigid, with the cells arranged quincuncially in a single plane on one or both sides of the frond; in paleon., range in time from the Oolitic period till now.

ESCHATOLOGY, n. *ěs'kă-töl'ō-ji* [Gr. *eschātōs*, extreme, last; *logos*, speech, discourse]: the doctrine of the four last or final things as regards man—viz., death, judgment, heaven, hell; included in these, or introduced by them, are: the Millennium, and the Future Coming of Christ; the state of man, through a period more or less extended, immediately after death; the Resurrection through Christ; the Final Judgment as related to the End of the World; the ultimate delivering up of the kingdom of the Son of God to his Father: see HEAVEN: HELL: IMMORTALITY. ESCHATO-

ESCHEAT—ESCHENBACH.

LOGICAL, a. *ěs'kū-tō-lj̄'i-kăl*, pertaining to the last or final things.

ESCHEAT, n. *ěs-chēt'* [OF. *escheir*, to fall, to happen: *escheate*, the falling in of a property—from mid. L. *excadērē*, to fall upon, to meet—from L. *cūdērē*, to fall]: lands or tenements which fall or revert to the lord or superior through failure of heirs, or by forfeiture; lands, etc., falling to the state through want of heirs, or forfeited by rebellion: V. to revert or fall to a superior, or to the state. ESCHEAT'ING, imp. ESCHEAT'ED, pp. ESCHEAT'ABLE, a. -ă-bl, liable to escheat. ESCHEAT'OR, n. -ér, an officer who looks after escheats. ESCHEAT'AGE, n. -āj, the right to succeed to an escheat.—*Escheat* was an incident of the feudal law whereby, when a tenant in fee-simple died, leaving no heir capable of succeeding, the land reverted to his lord. According to the law of England, if the owner of an estate in fee-simple dies without leaving an heir, and without having disposed of his estate by deed or will, the land reverts to the overlord, who in the present day is almost invariably the sovereign, except in copyhold estates, which escheat to the lord of the manor. The species of escheat in English law, under attainder for treason or murder, is to be distinguished from forfeiture of lands to the crown for treason, which prevailed in other countries besides England: see FORFEITURE.

In the United States the original and ultimate proprietor of all lands is the state in virtue of its sovereignty, and to it reverts the title of all lands which under the laws of England would go to the lord of the manor or to the crown. In most of the states E. is regulated by statute.

ESCHELLES, *ā-shĕll'*, LES: village in Savoy (formerly a Sardinian, now a French state, on the Guier, 12 m. s.w. of Chambéry. The valley beyond this village and on the road to Chambéry is blocked up by a huge limestone rock 800 ft. high, over which travellers formerly used to climb by means of ladders, and hence the name given to this village. Through this mass of limestone the public road now passes in a tunnel 25 ft. high, 25 ft. wide, 1,000 ft. long. The tunnel was projected and commenced by Napoleon I., and finished 1817 by the king of Sardinia.

ESCHENBACH, *ěsh'én-bách*, WOLFRAM VON: celebrated poet of the middle ages; b. in the second half of the 12th c., of a noble family, which derived its name from the village of Eschenbach near Ansbach; d. between 1219 and 25. He received the honor of knighthood at Henneberg, and passed his life in knightly fashion. In 1204, he came to the court of Hermann, landgraf of Thuringia, where he shone among the poets of the time, at the so-called Wartburg-war (a rivalry of the German minstrels at Wartburg 1206 or 7). E. withdrew from the Thuringian court toward the close of his life. E.'s poems are partly original, partly after French and Provençal models. His rich fancy, deep sentiment, and vivid power of representation, as well as his elegant mastery of language and versification, give

ESCHER—ESCHWEGE.

something of an epic character to his works, the principal of which are *Parcival*, composed before 1212, *Wilhelm von Orange*, and *Titurel*. Besides these, we have several love-songs of his. E. exercised an important influence on his time, but subsequently was almost forgotten; and it is only recently that he has been restored to his place of honor. The first critical edition of his works was that by Lachmann (Berl. 1833). They were translated into modern German by San-Marte (2 vols. Magdeb. 1836–41), and with greater accuracy, though with too slavish literalness, by Simrock (2 vols. Stuttg. 1842).

ESCHER, ēsh'ēr, JOHANN HEINRICH, ALFRED: 1819, Feb. 20—1882; b. Zurich: distinguished Swiss statesman. He studied at Bonn and Berlin. In 1842, he was created doctor of law at Zurich; and spent the two following years in Paris, devoting his attention chiefly to studies connected with Roman law. On his return to Zurich, E. became a lecturer on Swiss political law, in the High School. In 1844, he was elected member of the great council of the canton, and was drawn into the arena of practical statesmanship. His sentiments were decidedly liberal. In 1845, Jan., with six others who shared his opinions, he published the famous summons to the popular assembly in Unterstrass for the expulsion of the Jesuits. His election into the council of the interior 1845, and into the council of education 1846, opened a wide field for his administrative talents in his native canton. The reorganization of the schools is chiefly his work. In 1847, Dec., he became pres. of the great council; and in his opening speech, recommended the complete reform of the confederacy, and the greatest possible centralization. In 1848, he was sent as deputy to the federal diet, and became pres. of the council of regency; in 1849 pres. of the national council. Latterly he was engaged in promotion of railway enterprise and banking institutions in Switzerland.

ESCHEW, v. ēs-chō' [OF. *eschever*, to avoid: It. *schivare*, to avoid, to parry a blow: O.H.G. *sciuhan*, to frighten Sw. *skef*; Dan. *skieve*, oblique]: to avoid; to flee from; to shun. ESCHEW'ING, imp. ESCHEWED, pp. ēs-chō'd'.

ESCHOLTZ BAY, ēsh'olts: portion of the Arctic Ocean in Alaska, the innermost part of Kotzebue Sound, first great inlet n. of Behring's Strait. It is about long. 161° w., being barely outside the polar circle. It has fossil remains, comparatively rare on that portion of the American continent, though common on the n. coast of Siberia.

ESCHSCHOLTZIA, n. ēsk-shōlt'zī-ă: genus of plants of the nat. ord. *Papaveraceæ*, of which are *E. Californica* and other species, natives of California, very showy with their large deep yellow flowers. The genus is remarkable for the calyx, which separates from the dilated apex of the flowerstalk, being thrown off by the expanding flower, and much resembling in its form the extinguisher of a candle.

ESCHWEGÉ, ēsh'rā-gēh: a town of Prussia, in the province of Hesse-Nassau, is situated on the left bank of the

ESCHWEILER—ESCUAGE.

Werra, 25 miles e.s.e. of Cassel. It consists of an old and new town, and a suburb; is surrounded with walls pierced by six gates; and is well built. The only building of note is the castle, which was long the residence of the landgrafs of Hessen-Rotenberg. E. has manufactures of woolen and linen fabrics, numerous tanneries, and several oil and other mills, also some trade in fruit and victuals. Pop. (1890) 9,776.

ESCHWEILER, *ěsh'vī-lēr*: town of Rhenish Prussia, in the circle of Aachen, nine m. e.n.e. from the city of Aachen (Aix-la-Chapelle). It is a station on the railway between Aix-la-Chapelle and Cologne, at the confluence of the Inde and Dente. It has extensive manufactures of ribbons, woolens, canvas, needles, iron-wire, and machinery, also of wax-cloth, lace, glass, vitriol, and vinegar. In the vicinity are mines of zinc and lead. Pop. (1890) 18,119.

ESCLATTÉ, a. *čs'klūt tā* [OF. pp. of *esclater*, to shiver]: in *her.*, term applied to anything shivered by a battle-ax.

ESCOBEDIA, n. *čs-ko bědī-a* [named after *Escobedo*, a Spanish botanist]: in *bot.*, typical genus of *Escobedieæ*, of the tribe *Scrophulariaceæ*, sub-order *Antirrhinideæ*.

ESCORT, n. *čs'kōrt* [F. *escorte*—from It. *scorta*, a convoy, a guide—said to be from L. *ex-corrigērē*, to set right: comp. L. *cohors*, a company of soldiers]: a body of armed men to attend or protect any person of distinction on a journey; a guard for the safety of baggage, etc. (see CONVOY): V. *čs'kōrt'*, to attend as a guard on a journey; to accompany; to attend and guard anything conveyed by land. ESCORT'-ING, imp. ESCORT'ED, pp. guarded on a journey or excursion; attended.

ESCOT, v. *čs kōt'* [OF. *escot*, payment of one's share of a common expense: Icel. *skot*; Scot. *scat*, a tax, money-payment]: in *OE.*, to pay a man's reckoning; to support; to pay. ESCOT'TING, imp. ESCOT'TED, pp. paid; supported; see SCOT.

ESCRITOIRE, n. *čs'kři-tvaur'* [OF. *escritoire*, an ink-stand—from mid. L. *scriptōrium*, a writing-room or study]: a box or case with a desk and materials for writing; a writing-table or cabinet.

ESCROD, n. *čs-krōd'*: a small cod broiled; a scrod.

ESCROL, n. *čs-krōl'*: in *her.*, a scroll; a slip of paper, parchment, etc., on which the motto is written.

ESCUAGE, n. *čs'kū-āj* [OF. *escusson*, diminutive of *escu*, a shield—from It. *scudo*; L. *scutum*, a shield]: literally, service of the shield; a commutation for the personal service of military tenants in war. ESCUTCH'EON, n. *-kūch'ūn*, the shield on which a coat of arms is represented; a hatchment; picture of the ensigns armorial. ESCUTCH'EONED, a. *-ūnd*, having an escutcheon or hatchment. Note.—The two sides of the front of a shield or escutcheon are named respectively the *dexter*, that is, the *right*, and the *sinister*, that is, the *left*, with reference to the right and left hand of the bearer. To the eye of the spectator they are of course exactly reversed.

ESCUDO—ESCURIAL.

ESCUDO, n. *ĕs-kō'dō*: in *numis.*, Spanish coin containing ten reales. Ten escudos are equal to one pound sterling.

ESCUDO DE VERAGUA, *ĕs-kō'dō dā vā-rá'gwā*: river on the Atlantic side of Central America—having at its mouth an island of the same name. The river and island are a little e. of the boundary between New Granada and Costa Rica; the island in lat. 9° n., and long. 81° 30' w. The river, only 15 m. long, is noticeable only from the narrowness of the belt which here separates the Atlantic and Pacific.

ESCOLAPIAN, a. *ĕs'kū-lā'pi'-ăn* [*Æsculapīus*; Gr. *Asklēpiōs*, the god of the healing art in anc. mythology]: pertaining to the healing art; medical; also spelled *ÆSCULAPIAN*: see *ÆSCULAPIUS*.

ESCULENT, a. *ĕs'kū lĕnt* [L. *esculēntus*, fit for eating-edible—from *esca*, food]: good for food; eatable: N. some, thing that is eatable.

ESCURIAL, *ĕs-kō-rē-āl'* (correct title, EL REAL SITIO DE SAN LORENZO EL REAL DE ESCORIAL): famous monastery of New Castile, province of Madrid, 30 m. n.w. of the town of Madrid. This solitary pile of granite has been called the eighth wonder of the world, and at the time of its erection surpassed every building of the kind in size and magnificence. It owes its origin (at least so it is said) to an inspired vow made by Philip II. during the battle of St. Quentin. On that occasion, he implored the aid of St. Lorenzo, on whose day, 1557, Aug. 10, the battle was fought; and vowed that, should victory be granted him, he would dedicate a monastery to the saint. The E. is built in the form of a gridiron, in allusion to the instrument of St. Lorenzo's martyrdom, and forms a huge rectangular parallelogram 744 ft. from n. to s., and 580 ft. from e. to w., and divided into long courts, which indicate the interstices of the bars. Towers at each angle of this parallelogram represent the feet of the gridiron, which is supposed to be lying upside down; and from the centre of one of the sides, a range of building abuts, forming the royal residence, and representing the handle. The E., begun 1563, finished 1584, was intended to serve as a palace, mausoleum, and monastery. It has a splendid chapel with three naves, 320 ft. long, and 320 in height to the top of the cupola. The Pantheon, or royal tomb, is a magnificently decorated octagon chamber, 36 ft. in diameter by 38 ft. high, in the eight sides of which are numerous black marble sarcophagi. Kings only and the mothers of kings are buried here. The E. is an immense building; it is stated that it has 14,000 doors and 11,000 windows, and its cost was 6,000,000 ducats. Its library, previous to the sack of the E. by the French 1808, contained 30,000 printed and 4,300 ms. vols. mainly treasures of Arabic literature, of which a catalogue, but not a good one, was drawn up by Casiri in his *Bibliotheca Arabico-Hispanica* (2 vols. Madrid 1760–70). They were, however, at that time, removed to Madrid; and on being sent back to the E., it was discovered that the library con-

ESCUTCHEON—ESDRAS.

sisted of only about 20,000 vols.—a third having been lost. The French also plundered the place of its valuable collection of coins, medals, and pictures. In 1872, Oct. 2, the E. was struck by lightning, and partially burned. The E. is saved from falling into ruin by occasional grants of public money.

ESCUTCHEON, see under ESCUAGE: in *heraldry*, synonymous with shield (q.v.).

ESCUTCH'EON OF PRETENSE, or INESCUTCH-EON, in Heraldry: a small shield placed in the centre of the larger one, and covering a portion of the charges on the latter, in which a man carries the arms of his wife when she is the heiress of her family. It is said to be carried *surtout*, or over-all. Sometimes also a shield over-all is given as an honor.

ESDRAËLON, *ĕs-dra-ĕlon* [Greek form of the Hebrew Jezreel]: large and celebrated plain in central Palestine. It is triangular in shape with its apex toward the south near Jenin. From this point its eastern side, extending north about 15 m. and forming the watershed of the region, strikes the hills of Galilee two m. s.e. of Nazareth. Its n. side, inclining toward the s.w., is 12 m. long; and its s.w. skirting the hills of Samaria for more than 18 m., comes back to Jenin. From this main body three branches go out toward the e., the middle one of which is the valley of Jezreel, so famous in the history of Israel. The whole extent of the plain, naturally very fertile, is now a desolation. From the days of Barak and Sisera to those of Napoleon, it has been, because of its extent and central position, conspicuous as a thoroughfare for great armies, and as a fiercely contested battle-field; and for this reason it is, under one of its names—Megiddo—used in the book of Revelation as an emblem of the ground on which the final contest will be decided between the powers of light and darkness.

ESDRAS, *ĕs'dras* or *ĕz'dras*, Books of: portion of the Old Testament Apocrypha (q.v.). (The word *Esdras* is the Greek form of Ezra, and indicates that the books so named do not exist in Hebrew or Chaldee). In the Vulgate, the first book of Esdras means the canonical book of Ezra; and the second, the canonical book of Nehemiah; while the third and fourth are what we call the first and second books of Esdras. But in the Vatican and other editions of the LXX., what we call the first book of Esdras comes first, and is followed by the canonical book of Ezra, termed the *second* book of Esdras. In all the earlier editions of the English Bible, the order of the Vulgate is followed. The Geneva Bible was the first to adopt the classification now used, according to which Ezra and Nehemiah give their names to two canonical books, and the two apocryphal become first and second Esdras. As regards the *first* book of Esdras, it is for the most part a transcript—not very accurate—of Ezra and a portion of Nehemiah, together with the two last chapters of II. Chronicles. It is impossible to ascertain anything regarding its age or authorship. Josephus quotes it extensively in his Antiquities,

ESEMPLASTIC—ESK.

even when it contradicts *Ezra* proper, a fact which indicates that it was highly valued by the Jews. The hackneyed phrase, *Magna est veritas et prevalebit* (Truth is great, and will prevail), is taken from chap. iv., v. 41, of this book. The second book of Esdras, or Revelation of Esdras, is wholly different in character from the first, and it has even been doubted whether it is the work of a Jewish, or of a semi-Christian writer. Lawrence and Hilgenfeld argue for its being composed B.C. 28–25; Lücke, shortly after the death of Cæsar (B.C. 44); while Gfrörer, Bauer, and Wieseler assign it to a period as late as the reign of Domitian (A.D. 81–96). The opinion which has the weightiest evidence is, that the book was originally the composition of a Jew, but that it has been largely interpolated by Christian writers. The book was written probably in Egypt, and forms part of what has been called the 'Apocalyptic Cycle' of Jewish literature (see REVELATION OF ST. JOHN). It consists of a series of angelic visions and revelations made to Ezra, regarding the mysteries of the moral world, and the final triumph of the righteous, who, however, are to be but 'a very few.' The descriptions are occasionally very striking, and even sublime, and if the doctrinal portions contain the original views of a man living before the apostolic era, the source of the Pauline phraseology can in part be discovered.

ESEMPLASTIC, a. [Gr. *es*, into; *hen*, one; *plastikos*, molding, shaping]: molding; shaping; fashioning into one.

ESENBECKIA, *ĕs-ĕn-bĕk'ĭ-a*: genus of trees of the nat. ord. *Diosmaceæ*. The bark of *E. febrifuga*, a tree 40 ft. high, native of the s. of Brazil, is said to be equal in its effects to Peruvian bark.

ESERINE, n. *ĕs'ĕr-īn* [*eséré*, native name for the Calabar bean]: in chem., physostigmin, $C_{15}H_{21}N_3O_2$; base contained in the Calabar bean. It is a yellow amorphous mass, very poisonous, causing contraction of the pupil of the eye.

ESK, *ĕsk* (Gaelic, *uisg*, water): name of several small Scotch rivers. The Dumfriesshire Esk is formed by the confluence of the Black and White Esk, which rise near the centre of the Southern Highlands. The united stream runs 35 m. s., and forms for a mile the boundary between Scotland and England, and finally falls into the head of the Solway Firth. The upper part of the valley of this E., which is wild and pastoral, is called Eskdale Muir.—The Edinburghshire N. and S. Esk rise in the n. of Peeblesshire, between the Pentland and Moorfoot Hills, and both run n.n.e. through a beautiful tract in the east of Edinburghshire. The two branches unite in Dalkeith Park, and run into the Firth of Forth at Musselburg.—The Forfarshire N. and S. Esk rise in the Grampians; the N. flows 25 m. s.e. into the sea, 4 m. n. of Montrose. The S. Esk flows 40 m. s.e. and e., crossing the valley of Strathmore, passing Brechin, and ending in the tidal lagoon of Mont-

ESKAR, *ĕs'kar*, or **Eskir**, or **ESCAR**: term applied in Ireland to certain objects in the superficial drift, in several parts of that country; known also in Scotland as *kaims*, but more abundant in Sweden than in any other known country, being there recognized as *ösar*. An *eskar* is generally a long linear ridge of rounded gravel, chiefly of carboniferous limestone, including pieces of considerable size; in Sweden, they often have rough erratic blocks deposited upon them: they are sometimes heaped in narrow ridges 40 to 80 ft. high, and 1 to 20 m. long. It is an unsettled point whether they are connected with glacial action; if connected with it, the whole appearances and consistency demonstrate at least subsequent marine action. There is a remarkable *eskar* on a moor spreading below Dirlington Law, in Berwickshire, Scotland (900 ft. above the sea); another, about a mile long, has been pointed out amid a vast alluvial accumulation at St. Fort, Fifeshire. See MORAINE: GLACIER.

ESKI-DJUMNA, *ĕs'kē-jōm'nā*: town of the principality of Bulgaria, 20 m. w. of Shumla. Estimated Pop. 10,000.

ESKIMO, n. *ĕs'kī-mō*: another spelling of ESQUIMAUX, which see.

ESKI-SAGRA, *ĕs'kē-sā-grā*: town of European Turkey, province of E. Roumelia, at the s. base of the Balkan Mountains, 70 m. n.w. of Adrianople. In the vicinity are numerous gardens and orchards, also several mineral springs in great repute. The manufactures are carpets, coarse linens, and leather. Pop. 15,000 to 20,000.

ESLA, *es'lā*: river of Spain: important affluent to the Douro, rising in the province of Palencia, Old Castile, from the s. base of the Asturias Mountains, 10 m. n.w. of the town of Valleburon. Through its whole course, it flows s.w., and joins the Douro 15 m. below the town of Zamora; length 125 m. Its waters, which are joined by numerous streams, are well stocked with fish.

ESMARCH, *es'mār̄ch*, JOHANNES FRIEDRICH AUGUST: distinguished German surgeon; b. Tönning, Schleswig-Holstein, 1823, Jan. 9. He received his medical and surgical education in the Universities of Kiel and Göttingen, was attached to the Kiel hospital 1846, served through the Schleswig-Holstein war as army surgeon, and was taken prisoner with the greater part of the army 1848, Apr. 6. After being exchanged, he was appointed surgeon to the hospital of Flensburg, and in the following campaigns was aid to Surgeon de Stromeyer. In 1857, he succeeded Stromeyer as director of clinical surgery, and 1860 was appointed prof. and director of the Kiel hospital. In 1870 he was a member of the hospital commission of the Prussian army, and while his health would not permit him to accompany the army into France, he organized the general ambulance service, and the special hospitals at Kiel, Hamburg, and elsewhere. He also introduced a system of bloodless operations. After the war he returned to his duties at Kiel Univ. His first wife was daughter of Prof. Stromeyer, and his second the Princess Henrietta of

ESMERALDAS—ESOCIDÆ.

Schleswig-Holstein. In the autumn of 1888 he made a trip to the United States and performed a remarkable surgical operation in New York in the presence of some of the most distinguished surgeons in the country. He is author of numerous medical, surgical, and sanitary publications.

ESMERALDAS, *ës-mä-räl'dás* (Sp. for *Emerald*): province in the n.w. part of the state of Ecuador (q.v.), S. America; watered by the E. river. It is mostly covered with forests, but produces excellent cacao and tobacco. Pop. (1885) 11,146.

ESMERALDAS RIVER: rising near the city of Quito, in Ecuador, S. America; entering the Pacific after a course of 110 m.; lat. $1^{\circ} 5'$ n., and long. $79^{\circ} 40'$ w.—Ten m. from its mouth is the town of Esmeraldas; pop. abt. 4,000.

ESNÉ, *ës'nā*, or ESNA, *ës'na*, or ESNEH, *ës'nē*, the hieroglyphic *Sen*, and the Greek *Latopolis* or *Lattónpolis* (the city of the Latus fish or *Latus nobilis*, from the fish there worshipped): thriving but badly built town of Upper Egypt, on the left bank of the Nile, lat. $25^{\circ} 15'$ n. It has some manufactories of fine cotton, shawls, and pottery. It is an entrepôt for the Sennaar caravans. There are famous ruins at E., of a sandstone temple, with a portico of four rows of six columns, which appears to have been founded by Thothmes III., whose name is seen on the jambs of a door. The temple, however, seems to have been restored or principally constructed by Ptolemy Euergetes (B.C. 246–222), and the pronaos was erected in the reign of Emperor Claudius A.D. 41–54), and completed in that of Vespasian. The interior is of the date of Trajan, the Antonines, and Geta, whose name, erased or replaced by that of Caracalla, is there found. The great temple was dedicated to Chnumis, Satis, and Har-Hek. It has a zodiac like that of Denderah, formerly thought to be of the most remote antiquity, but now known to be no older than the Romans. A smaller temple with a zodiac, erected in the reign of Ptolemy Euergetes, formerly stood at E'Deyr, $2\frac{1}{2}$ m. n. of E., but it has been destroyed. At E. is also a stone quay, bearing the names of M. Aurelius. This city was the cap. of a nome, and the coins struck in it in the reign of Hadrian, A.D. 127–128, represent the fish latus.—Champollion, *Not. Descr.* p. 283; Wilkinson, *Mod. Egypt*, II., p. 268; Tochon d'Annecy, *Médailles*.—Pop. abt. 12,000, of which many are Copts.

ESNECY, n. *ës'në-si* [F. *aïnesse*, priority of birth]: in law, right, under some laws, of the eldest coparcener in the case where an estate descends to daughters jointly for want of an heir male, of making the first choice in the division of the inheritance.

ESO, pref. *ës-ō* [Gr. *esō*, *eisō*, to, within, into]: within.

ESOCIDÆ, n. plu. *ë-sö's'i-dë* [L. *esōx*, or *esōcem*; Gr. *isox*, a species of pike]: family of malacopterous fishes; now regarded as including only the pikes (q.v.), but in which the flying fishes (*Exocetus*) and other fishes, now constituting the family *Scomberesocidae* (q.v.), and of the order *Pharyngognaths*, were until recently included.

ESODIC—ESPALIER.

ESODIC, a. *ěs-ǒd'ik* [Gr. *eis*, into; *hodos*, a way]: in *phys.*, conducting influence to the spinal marrow. (Used of the nerves which have this function.)

ESOENTERITIS, n. *ěs-ǒ-ěn-tér-ǐ'tis* [pref. *eso-*; Eng. *enteritis*]: in *pathol.*, inflammation of the mucous membrane of the intestines.

ESOGASTRITIS, n. *ěs-ǒ-găs-trǐ'tis* [pref. *eso-*, Eng. *gastritis*]: in *path.*, inflammation of the mucous membrane of the stomach.

ESOPHAGUS, n. *ě-sőf'ă-güs*: the passage through which food and drink pass to the stomach; the gullet. Spelled also **ŒSOPHAGUS** (q. v.).

ESOPIAN, a. *ě-ső'pi-ǎn* [from *Æsop*, an anc. Greek who wrote fables]: composed by *Æsop*; after the manner of *Æsop* (q. v.).

ESOPUS, *ě-sō'pūs*: original name of the settlement at or near what is now the city of Kingston (q. v.), N. Y.—**Esopus War**, a series of conflicts at E. between the Dutch settlers and the Indians, 1658–64; ending in the burning of the village of Wietwyck, the killing of 21 settlers, and the captivity of 40 women and children.

ESOTERIC, a. *ěs'ō-tér'ik* [Gr. *esōtērīkōs*, belonging to what is interior or abstruse—from *ěsō*, within]: term derived from the anc. mysticism, denoting private; secret; pertaining to doctrines taught in private only to the initiated; opposed to *exoteric*, denoting the form of such doctrines taught to the public. **Es'OTER'ICAL**, a. -ǐ-kăl. **Es'OTER'ICALLY**, ad. -ǐ. **Es'OTER'ICS**, n. plu. -ǐks, mysterious or hidden doctrine.

ESPADON, n. *ěs'pă-dōn* [It. *spadone*, a two-handed sword—from *spada*, a sword]: a long heavy sword wielded by a powerful foot-soldier, or used in decapitating by an executioner.

ESPALIER, n. *ěs-pă'l'yér* [F. *espalier*, railing on which fruit-trees are trained as though against, or actually against a wall—from It. *spalliera*, the back of a chair, an espalier: Sp. *espaldera*, wall-trees—from *espalda*, a shoulder]: railing or trellis on which fruit-trees are trained in a row. By allowing the air and sunlight to pass freely among the leaves this system promotes early ripening of the fruit, prevents injury to the branches and loss of immature fruit from winds, and requires but little land. It is nearly equal to wall training for which it is an excellent substitute. The apple, pear, peach, and nectarine, are most frequently grown in this manner. A common method is to nail slats or wires to a line of posts and close to these set a row of very small trees. Shoots which are form to the arms of the trees are tied to the trellis in the desired position. Fruit is produced on the short laterals which are allowed to grow from these arms. In the case of trees which produce fruit on new wood, a succession of laterals is secured by skilful pruning, the old ones being removed after fruiting. The arms are trained in a horizontal position, in the style of a fan, or of a wine glass, and in various other artificial forms.

ESPARTERO.

In the oblique rod system the stem is trained at an angle of about 45 degrees, while the oblique double rod method allows two branches, which are bent in a similar manner. The flow of sap is thus retarded, productiveness is increased, and the quality of the fruit improved. In the cordon, or hedge-row method, the trees are set only 16 inches apart, trained to a trellis, and very closely pruned. An inclined trellis is frequently used where special protection from cold is desired. The espalier, common in Europe, has been used in this country only in growing very tender varieties and for ornamental purposes. See FRUIT: FRUIT-GARDEN: ORCHARD-HOUSE.

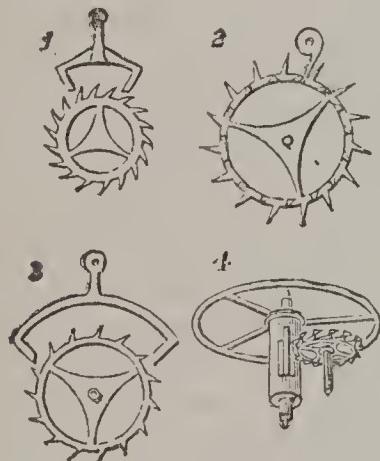
ESPARTERO, *es-par-tā'rō*, JOAQUIN BALDOMERO: Ex-regent of Spain, Count of Luchana, Duke of Vittoria, etc.: 1792–1879, Jan.; b. Granatula, in La Mancha (Ciudad Real), where his father, Antonio E., was a cartwright. E. was intended for the ecclesiastical profession, and in 1806 went to the Univ. of Almagro, but two years later, on the invasion of Spain by the French, he entered the Sacred Battalion (*Batallon Sagrado*), composed almost entirely of students. After the close of the War of Independence 1814, he went to S. America, where he fought against the insurgents; but after the victory by Bolivar at Ayacucho, 1824, Dec. 9, had put an end to the Spanish rule on the continent of America, E. returned to Spain. In 1832, he declared himself openly in favor of the succession of the daughter of Ferdinand VII.; and on the breaking out of the civil war after the king's death, he soon rose to the rank of lieut.gen. In 1836, Aug., he succeeded in saving the city of Madrid, and became successively gen.-in-chief of the army in the north, viceroy of Navarre, and capt.gen. of the Basque provinces. When the army of Don Carlos appeared before Madrid, 1837, Sep. 12, E. had again the glory of saving the capital. His successful campaign, 1839, which resulted in the expulsion of Don Carlos from Spain, procured him the title of Grandee of Spain, and Duque de la Vittoria y de Morella. In 1840, the queen-mother Christina was compelled to resign her office of regent, and 1841, May 8, E. was appointed by the cortes to supply her place until the queen (Isabella) should have reached her majority. E. guided the helm of the state with energy, firmness, and ability; but in 1843, an unscrupulous and unprincipled combination of parties naturally inimical to each other, the republicans and the moderados, brought about his fall, and E. sailed for England, where he resided four years. In 1847, he returned to Spain, and lived quietly at Logroño till 1854, when the wretched despotism and profli-gacy with which the name of Christina is associated, caused an insurrection of the people, and compelled the queen-mother to leave the kingdom. E. was again called to the head of the govt., and conducted the affairs of the nation for two years; but 1856, July, he was supplanted by General O'Donnell. In 1857 he resigned his dignity as senator, and after that time rarely took part in politics. After the revolution 1868, which resulted in the expulsion of Queen Isabella, E. gave his full and hearty adhesion to the

PLATE 4.

Erodium
Espartero



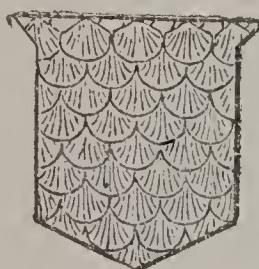
Erodium: 1, Stamens and Styles.



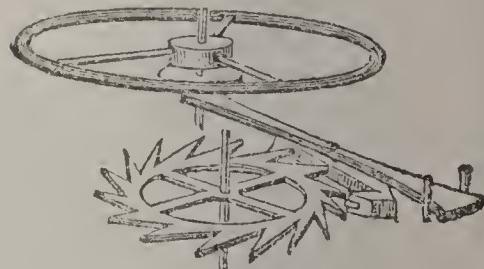
Watch and Clock Escapements:
1, Anchor escapement of a common clock; 2, Duplex escapement; 3, Lever escapement; 4, Horizontal or cylinder escapement.



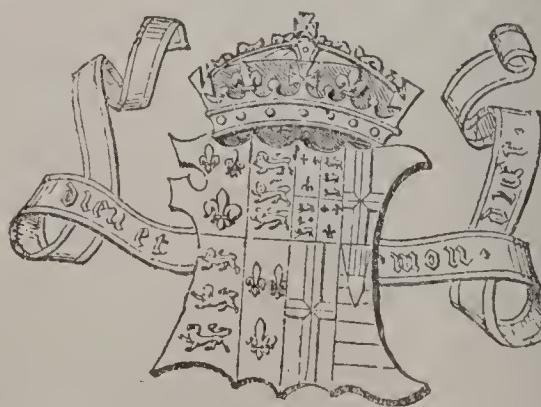
Espartero Grass (*Stipa tenacissima*).



Escallopée.



Escapement.



Escutcheon of Elizabeth, Queen of Henry VII.

ESPARTO—ESPINEL.

provisional government, though he took no part in their proceedings. In 1870, E. was induced to become a candidate for the throne of Spain; but withdrew in June of the same year, alleging his age and the division of parties as excuse. In 1875 he adhered to King Alfonso.

ESPARTO, n. *ĕs-păr'tō* [Sp. *esparto*—from L. *spartum*; Gr. *sparton*, Spanish broom], (*Stipa* or *Macrochloa tenacissima*): species of grass nearly allied to the well-known and beautiful feather-grass (q.v.), native of the s. of Europe (especially Spain) and n. Africa. It is used by the Spaniards for making sandals, nets, sacks, etc.; and has become an important material in paper-making. As supplies for this purpose have fallen off of late through the reckless custom of tearing up the grass by the roots, attention has been directed to various substitutes, including what has been called Irish esparto (*Molinia cærulea*), which grows wild on Irish waste land.

ESPATHATE, a. *ĕ-spā'thāt* [L. *e*, out; *spatha*, the spathe of a palm-trec]: in bot., not having a spathe.

ESPECIAL, a. *ĕs-pĕsh'ăl* [OF. *especial*—from L. *speciālis*, not general—from *speciēs*, a kind: It. *speciale*: F. *spécial*]: chief; principal; particular. **ESPECIALLY**, ad. *-lī*, principally; particularly; in an uncommon degree above any other. **ESPECIALNESS**, n.

ESPEJO, *ĕs-pă chō*: small town of Spain, 20 m. s.e. of Cordova. It has an ancient castle. Pop. 5,284.

ESPERANCE, n. *ĕs'pĕr-ăns* [F. *espérance*, hope—from *espérer*, to hope—from L. *spērārē*]: in O.E., hope; expectation.

ESPIED, ESPIAL, SPIER: see under **ESPY**.

ESPINASSE, *ĕs-pĕ'năs'*, JULIE JEANNE ELEONORE DE l': one of the most fascinating women of her time, combining sparkling gifts with an affectionate disposition: 1732, Nov. 19—1776, May 23; b. Lyon, France; illegitimate daughter of a Mme. d'Albion. After the death of her mother, Mlle. de l'E., who had received an excellent education, went, as *gouvernante*, to the house of her brother-in-law, the Marquis de Vichy-Chamroud. In 1752, she went to Paris as *demoiselle de compagnie* to the Marquise Du Deffand (q.v.). The two ladies lived together agreeably, until a rupture resulted from the admiration which the young and beautiful *demoiselle* attracted from the circle in which Du Deffand had formerly been the chief attraction. Even D'Alembert, the famous encyclopédist, hitherto the most constant admirer of Du Deffand, gave his devotion to the more fascinating Espinasse. The friends of E. obtained for her, through the Duc de Choiseul, an annuity from the king. It is said that D'Alembert sought her hand in vain. Her *Lettres*, etc. (Paris 1809), show her remarkable cultivation.

ESPINEL, *ĕs-pĕ-nĕl'*, VINCENT DE: 1551, Dec. 28—1634; b. Ronda in Granada: Spanish poet and musician. He studied at Salamanca, afterward entered into the army, and travelled as a soldier through Spain, France, and Italy,

ESPINHACO—ESPLANADE.

meeting with the adventures which he relates in his *Relaciones de la Vida y Aventuras del Escudero Marcos d. Obregon* (Madr. 1618, later 1804; in German, by Tieck-Bres. 1827). He afterward returned to his native country, entered into holy orders, and received a benefice in Ronda, his native town. He was subsequently chaplain in the royal hospital at Ronda. The last years of his life were spent at Madrid, in the retirement of the monastery of *Santa Catalina*, where he died. He published a book of poems (Madr. 1591), chiefly lyrics, and a translation of the *Epistola ad Pisones*, the *Ars Poetica* of Horace. He was, if not the inventor, the improver of the ten-line octosyllabic stanza. Verses in this form have, since E.'s day, been called in Spain *Espinelas*. He was a performer on the guitar, to which he added the fifth string.

ESPINHACO, *ĕs-pĕn-yá'so* (SERRA DO): mountain-chain of Brazil, extends in a direction generally parallel with the coast, from the right bank of the San Francisco to the head-waters of the Uruguay. Its n. part forms the e. limit of the basin of the former river. The Serra, as a whole, is said to be rich in diamonds.

ESPIONAGE. n. *ĕs'pē-ō-nāj'* or *-nāzh'* [espionage, act of spying—from *espion*, a spy—from It. *spione*]: the practice of watching the words and conduct of others, generally from unworthy motives; the practice of employing others as spies or secret agents.

ESPIRITU SANTO, *ĕs-pĕr'i-tō sán'tō* or *ĕs-pĕr'i-tó sán-tō* (long applied by the Spaniards to their imaginary continent in the s. hemisphere): largest and most westerly island of the New Hebrides, lat. 15° s., and long. 167° e.; said to measure 80 m. by 40.

ESPIRITU SANTO: cape of Tierra del Fuego, lat. 52° 38' s., long. 68° 37' west.

ESPIRITU SANTO: bay of the Gulf of Mexico, forming part of the almost continuous back-water of Texas; lat. 28° 30' n., and long. 97° 30' w. Toward the open sea, it is breasted by Matagorda Island, and on the side of the mainland, it receives the Guadalupe.

ESPIRITU SANTO: small maritime province of Brazil, extending in s. lat. 18° 30' to 21° 20'; immediately n. of the metropolitan province of Rio Janeiro. It contains also a town and bay of its own name. Pop. (1890) 135,997.

ESPIRITU SANTO: town near the centre of Cuba; pop. 9,982, fully one half being whites.

ESPLANADE, n. *ĕs'plă-năd'* [F. *esplanade*, a planing, a levelling—from It. *splanata* for *spianata*, a levelled way—from L. *plānum*, level ground, a plain]: level ground within a fortified place or adjoining it, used for exercise, etc.; properly, the space between the fortifications or of the town and the glacis of the citadel. It requires to be at least 800 paces broad, that the enemy, in case of his getting possession of the town, may not be able to assail the citadel under cover of the nearest houses. For this purpose, the citadel must command the esplanade, and be able to send a direct fire into the streets opening upon it.—In old works

ESPOUSE—ESPY.

On fortification, the term is often applied to the glacis of the counterscarp, or the slope of the parapet of the covered way toward the country.

ESPOUSE, v. *ēs-pouz'* [F. *épouser*; OF. *espouser*, to wed: OF. *espouse*, a spouse, a wife—from L. *sponsa*, a betrothed one; *sponsus*, promised solemnly]: to promise or engage in marriage by a written contract; to betroth; to marry; to embrace or adopt, as a cause or opinion. **ESPOU'SING**, imp. **ESPOUSED'**, pp. *-pouzd'*, married; wedded. **ESPOU'SAL**, a. *-zäl*, relating to the act of espousing: N. act of espousing or betrothing; adoption. **ESPOU'SALS**, n. plu. *-zälz*, the act of contracting a man and a woman to each other in marriage. **ESPOU'SER**, n. *-zér*, one who. **ESPOUSE'MENT**, n. *-pouz'mēnt*.

ESPRINGAL, *ēs-prīng gal*, or **SPRINGAL**, *spring'gal*: in *milit. eng.* before the days of gunpowder, a machine for throwing missiles. These missiles were either large darts, called *muchettes*, or arrows winged with brass and called *viretons*, from their whirling motion when shot forth. The espringal probably resembled in some degree the machine engraved in **BALISTA**.

ESPRIT, n. *ēs-prē'* [F. *esprit*, spirit—from L. *spiritus*, spirit]: spirit; soul. **ESPRIT DE CORPS**, *-dē kōr'* [F. *esprit*, spirit. *de*, of, *corps*, body]: the prevailing spirit or disposition which binds men as members of the same society or profession.

ESPRIT D'IVA, *ēs-prē'dē-vā*: aromatic liqueur made in Switzerland, from a plant called **GENIP** (*Achillea moschata*, or *Ptarmica moschata*; see **ACHILLÆA**). Like the *Swiss tea*, made from the same plant, it has sudorific properties.

ESPY, v. *ēs-pī'* [F. *épier*; OF. *espier*, to watch—from It. *spiare*, to spy]: to see a thing at a distance; to discover something meant to be concealed or not very visible. **ESPY'ING**, imp. **ESPIED'**, pp. *-pīd'*. **ESPI'ER**, n. one who. **ESPI'AL**, n. the act of spying; in *O.E.*, a spy; a scout. **ES'PIONAGE**, n. which see.—**SYN.** of ‘espy’: to discern; to spy; descry; discover; find out; perceive; watch; observe.

ESPY, *ēs-pī*, JAMES P.: meteorologist: 1785 (May 9)-1860, Jan. 24; b. in w. Penn.; son of a farmer. He received a superior education, and was a classical and mathematical instructor in Philadelphia; but became enthusiastic in meteorology, and gave up teaching. His first course of lectures was before the Franklin Institute of Pennsylvania. E.’s theory of storms (with which his name is specially connected) drew general attention: see **STORMS**. His memoir on this subject gained 1836, the Magellanic premium of the American Philosophical Soc. of Philadelphia. In 1841 appeared his work on the *Philosophy of Storms*, regarding which the Report of the *Académie des Sciences* (Paris) says, ‘that the theory on which it is based alone accounts for the phenomena. . . . It redresses many accredited errors.’ Later in his life, E. became prof. in the Philadelphia High School, and afterward in the Franklin Institute. He travelled extensively through the United States, lecturing on his favorite theory of storms, and studying the laws of climate, until he acquired the popular title of the ‘Storm-

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king.' After the organization of the Smithsonian Institution at Washington, he was commissioned by Dr. Henry, its superintendent, to pursue his researches. In the halls of the Smithsonian were made his experiments on the rate of cooling of gases of different densities when expanded. The cooling effects of expansion on dry and moist air also formed the subject of nice experiments. The results of these experiments have thrown much light on the formation of cloud and rain, and the propelling power of winds. They afforded materials for his elaborate and valuable reports on meteorology, of which the last was issued 1857. He died in Cincinnati.

ESQUIMALT, *ĕs'ké-mált*: small port at the s. end of Vancouver Island, on Juan de Fuca Strait; important as a British naval depot, the only one on the w. coast of the American continent. See VICTORIA (city in Brit. Col.).

ESQUIMAUX, n. sing. or plu. *ĕs'kí-mō* [a French spelling of a native name, *eskumaget*, he eats raw flesh—a nickname given to the Arctic tribes by the N. Amer. Algonquin Indians]: tribes of diminutive stature inhabiting the northern seaboard of America and Asia, and the Arctic islands: ESQUIMAU, as a sing. form, is rarely used. ESKIMO, *ĕs'kí-mō* (also ESKIMOS), is a common spelling, and adopted in Greenland. They are found on the coasts of all the seas, bays, inlets, and islands of America n. of the 60° of n. lat.; from the e. coast of Greenland, long. 20°, to the Strait of Behring, long. 167° w. On the Atlantic, they are found along the entire coast of Labrador to the Strait of Belleisle, and down the e. side of Hudson's Bay nearly as far as James's Bay; while on the Pacific they reach as far as the peninsula of Alaska. They are found also on the Asiatic side of Behring's Strait, and though few in number, may be regarded as the most widely spread nation in the world, occupying, according to Mr. Gallatin, not less than 5,400 m. of coast, without including the inlets of the sea. 'The Eskimo,' says Dr. Latham, 'is the only family common to the old and new world—an important fact in itself, and one made more important still by the Eskimo localities being the only localities where the two continents come into proximity.' Nothing, however, has as yet come out of a consideration of this fact in the way of tracing, with absolute certainty, a connection between the E. and any well defined Asiatic race. The name itself, *Esquimaux*, or *Eskimo*, does not help in any such attempt, being not the native name, for they called themselves 'Inuit,' or 'people;' the Scandinavians of the 10th c. called them 'Skroellingar,' or 'wretches;' while the seamen of the Hudson's Bay ships designate them as 'Seymos,' or 'Suckemos,'—appellations, according to Richardson, 'evidently derived from the vociferous cries of Seymo or Teymo with which the poor people greet the arrival of the ships.' The E. are usually reckoned by ethnologists to belong to the Mongolian race, but Duponceau and Gallatin find a strong resemblance between them and the Red Indians of N. America, the view also of Prichard—the

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last mentioned regarding them as a kind of link between the N. Asiatic and American family of nations. Latham, on the other hand, pronounces them Mongolian in physiognomy, with flat nose, projecting cheek-bones, eyes often oblique, and skin more brown than red or copper colored; thus presenting a marked contrast to the N. American Indians. Their language, however, is, he acknowledges, American in grammatical structure, being composed of long compound words, and regular, though remarkable, inflections. With respect to the complexion of the E., Sir John Richardson is of a different opinion from any of these authors, describing it as nearly white, when relieved from the smoke and dirt with which it is usually incrusted. Many of the young women, he considers, may even be called pretty, when this operation has been performed. 'The young men,' he says, 'have little beard; but some of the old ones have a tolerable show of long gray hairs on the upper lip and chin, which the Red Indians never have, as they eradicate all stray hairs. The Eskimo beard, however, is in no instance so dense as a European one.' In stature, the E. are usually represented as not more than five ft. in height; but the authority just mentioned describes them as ranging from five ft. to five ft. ten inches, and even more. They are broad-shouldered, and, when seated in their boats, look tall and muscular, but, when standing, appear to lose some of their height, from the shortness of their lower extremities. The E. live usually throughout their long lines of coast in small villages, containing about five or six families each. The men occupy themselves entirely in hunting, while the women perform the domestic drudgery, which consists principally in preparing the food, of which both sexes consume a large quantity. This is almost entirely of an animal nature, but not without variety, embracing the reindeer, geese, and other birds, the seal, walrus, salmon-trout, and various other fish. They are expert hunters and fishers, and, aided by their dogs, make considerable havoc among the arctic animal tribes. Where whales are common, August and September are devoted to the pursuit of these animals, and great joy is manifested when they capture any of them, as from the blubber of these they get their supply of oil for lights in the long winter season. Of vegetables, they scarcely taste except in autumn. 'Carbon is supplied to the system by the use of much oil and fat in the diet, and draughts of warm blood from a newly killed animal are considered as contributing greatly to preserve the hunter in health.' The habits of the E. are filthy and revolting in the extreme. A great part of their food is consumed without any attempt at cooking it, and they drink the blood of newly killed animals as the greatest delicacy. In the short summer, those who can afford it live in tents; but in the winter they all equally live in snow-huts, the stench of which, from the offal with which they are stored, and the filthy oil that gives them light, makes them insupportable to the European. The dress of both sexes is nearly the same, consisting of the skins of animals, rein-

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deer, birds, and even fish—whatever conduces most to warmth, without much regard to appearance; but in their winter abodes they usually wear nothing except trousers. Their religion consists principally in superstitious observances, but they believe, we are told, in two greater spirits, and many lesser ones. The Moravian mission in Greenland, commenced by the benevolent Hans Egede (q.v.), 1721, has succeeded in converting many to Christianity; and they are represented by the missionaries to be a mild and teachable people, easily led by kindness to distinguish between what is morally right and wrong. Where the missionaries, however, have not penetrated, arctic voyagers generally speak of them as honest among themselves, but incorrigibly dishonest, and prone to lying and exaggeration with strangers.—See Dr. Rink's *Tales and Traditions of the Eskimo*.

ESQUIMAUX' DOG: kind of dog extensively spread over the most northern regions of N. America and of e. Asia; large, powerful, with long rather curling hair, tail much curved over the back and very bushy, short and pointed ears, and somewhat wolf-like aspect. These dogs are much used for drawing sledges. They are very sagacious,



Esquimaux, Dogs, and Sledge for one person.

cious, docile, and patient. The color is generally black and white, brown and white, or dingy white.

ESQUIRE, n. *ĕs-kwīr'* or *ĕs'kwīr* [F. *écuyer*; OF. *escuyer*, one who attended on a knight and bore his lance and shield—from It. *scudiere*—from L. *scūtārius*, the shield-bearer—from *scūtum*, a shield]: in *chivalry* the shield-bearer or armor bearer to the knight, and hence was called *armiger* in Latin. He was a candidate for the honor of knighthood, and thus stood to the knight in the relation of a novice or apprentice, much as the page did to him. In this capacity he was spoken of as a bachelor, just as the knight-bachelor came latterly to be distinguished from him who had already attained to the higher honors of chivalry. When fully equipped, each knight was attended by two esquires. The

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esquire was a gentleman, and had the right of bearing arms on his own shield or escutcheon, which is surmounted by a helmet placed sideways, with its vizor closed, to distinguish him from a knight or nobleman. He had also the sword, the emblem of chivalry, though he was not girded with the knightly belt. His spurs were silver, to distinguish them from the golden spurs of the knight; and when the king created esquires of old, it was by putting silver spurs on their heels, and collars of SS round their necks. Those who received this honor directly from the sovereign were in general the esquires for the king's body, or those whose duty it was to attend him in his capacity of a knight; an office now nearly obsolete. Tenants of the crown who held by knight's service were a class of feudal esquires generally supposed to correspond to the simple *ritters* or knights of Germany, as opposed to the *ritters* who were *geschlagen* or dubbed, inasmuch as these English esquires were entitled to claim the rank of knighthood. Though the title of esquire has now come to be given almost without discrimination, the following seem to be those whose claim to it in Britain stands on the ground either of legal right or of long-established courtesy: 1. All the untitled sons of noblemen; 2. The eldest sons of knights and baronets; 3. The sons of the younger sons of dukes and marquises, and their eldest sons. All these are esquires by birth. Then there are esquires by profession, whose rank does not descend to their children; and esquires by office—e. g., justices of the peace—who enjoy the title only during their tenure of office. To the former class belong officers in the army and navy, barristers and doctors of law, and doctors of medicine, but not surgeons.

ESQUIROL, *es-ke-rol'*, JEAN ETIENNE DOMINIQUE: 1772, Jan. 4—1840, Dec. 12; b. Toulouse: one of the greatest physicians for the insane of modern times. He served in the military lazaretto at Narbonne 1794, obtained his degree of doctor 1805, and was appointed physician to the Salpêtrière at Paris 1811. After 1817, he delivered clinical lectures on the diseases of the mind, and their cures; in 1818, his exertions secured the appointment of a commission, of which he became a member, for the remedy of abuses in mad-houses; in 1823, he became inspector-gen. of the univ.; and in 1825, first physician to the *Maison des Aliénés*. In the following year, he was appointed also principal physician of the private lunatic asylum at Charenton, which he had organized. At the July revolution, he lost all his public offices, and withdrew into private life. E. combined rare qualifications for a physician of the body and the mind. By his humane and moral treatment of the insane, he often effected the happiest cures. His writings embrace all the questions connected with the treatment of insanity, and his special attention was given to the construction of suitable buildings for the insane. His most important work is *Des Maladies Mentales considérées sous les Rapports, Médical, Hygiénique et Médico-légal* (1838).

ESQUIROS, *es-ke-rōs'*, HENRI ALPHONSE: 1814-1876,

ESS—ESSAAD-EFFENDI.

May 13; b. Paris: poet and romancist; representative in the national assembly. He made his *début* as an author 1834, with a vol. of poems, *Les Hirondelles*, highly praised by Victor Hugo, but having a very limited sale. Two romances followed, *Le Magicien* (1837) and *Charlotte Corday* (1840). About this time he published a philosophic commentary on the life of Christ, the *Evangile du Peuple* (1840), for which he was prosecuted, and sentenced to eight months' imprisonment and to a fine of 500 francs, 1841, Jan. 30. In the same year he published his *Chants d'un Prisonnier*. His *Histoire des Montagnards* appeared 1847. After the revolution of 1848, Feb., E. was elected a member of the legislative assembly. Distinguished by his radical opinions, he was included, after 1851, Dec. 2, among members to be expelled; on which he retired to England. His *La Vie Future au Point de Vue Socialiste* appeared 1857; and *La Morale Universelle L'Angleterre et la Vie Anglaise*; and *La Neerlande et la Vie Hollandaise*, 1859. In 1869, he was returned to the corps législatif, and was appointed supreme administrator of dept. Bouches de Rhône by the govt. of the National Defense 1870. In 1871 he was returned to the national assembly, and 1876, Jan., was made a member of the senate. He died at Versailles.

ESS, *es*, HEINRICH LEANDER VAN, or JOHANN HEINRICH VAN: 1772, Feb. 15—1847, Oct. 3; b. Warburg, Westphalia: German Rom. Cath. theologian. He joined the Benedictine order in Paderborn 1790, was ordained priest 1796, was pastor at Schwalenberg 1799–1813, and prof. extraordinary of theol. at Warburg Univ. 1813–22. In conjunction with his cousin Karl van E. he published a German translation of the New Test. (Brunswick 1807; 20th ed. Sulzbach 1830), and independently one of the Old Test. 1819. In order to encourage the reading of the Bible by German Rom. Catholics, he prepared a large number of translations, tracts, and essays; but this course was censured by the German Rom. Cath. bps. and the pope, and this led him to resign his professorship and enter on a life of seclusion. After his death his library of between 13,000 and 20,000 vols., rich in early editions of the Bible and mediæval and reformation literature, was bought for the Union Theol. Seminary (Presb.), New York.

ESSAAD-EFFENDI, MOHAMMED: Turkish historian; b. Constantinople, 1790, Dec. 16. He was surnamed Sahaf-Zadeh, 'son of the bookbinder,' on account of his father having been president of a corporation of bookbinders and librarians. At the age of 18, he became a teacher; in 1825, he was appointed historiographer to the Ottoman empire. In 1831, the superintendence of the *Tatawin-i-wekaii* (Table of Events), the official journal of the empire, was placed in his hands. In 1835, he was employed by the late Sultan Mahmoud on an embassy to Mohammed, son and successor of the king of Persia. E. had also the titles of grand judge of Roumelia, inspector-gen. of schools, and member of the council of public instruction.

Among the works of E. are *Uss-i-Tzafer* (Establishment

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of Victory), translated into French, published by M. Causin de Perceval, entitled *Historic Summary of the Destruction of the Janizaries by the Sultan Mahmoud in 1826* (Par. 1833).

ESSAY, n. *ĕs'să* [F. *essayer*, to try—from L. *exāgiūm*, a trial of exact weight, proof by examination: F. *essai*, an essay, a sketch]: an attempt; an endeavor; an effort; a trial or experiment; a written composition on a practical subject, less formal or extended than a *treatise*. **ES'SAYIST**, n. *-ist*, writer of an essay: V. *ĕs-să'*, to attempt; to try; to endeavor. **ESSAY'ING**, imp. **ESSAYED'**, pp. *-săd'*. **ESSAY-ER**, n. one who. *Note*.—**ESSAY** and **ASSAY** are radically the same word.—**SYN.** of ‘essay, n.’: exertion; experiment; effort; treatise; tract; dissertation; disquisition; monograph.

ESSAYS AND REVIEWS: title of a volume published London, 1860, Mar., written by seven prominent members of the Church of England, in more or less opposition to the Tractarian principle of Oxford. They may be deemed representative of the ‘Broad Church’ views. It was severely censured by the majority of the bps. and a large number of the clergy, and was condemned by a convocation 1864, June 24. In the meantime two of its authors (Rev. Dr. Williams and Prof. Wilson) were tried by ecclesiastical courts and sentenced to suspension for a year and the payment of costs; but the sentences were subsequently reversed by the privy council. A third, Rev. Dr. Temple, was strongly opposed by the English Church Union when nominated to be bp. of Exeter, 1869, Oct., but ineffectually. The E. and R. were: *The Education of the World* by Rev. Dr. Frederick Temple; *A Review of Bunsen's Biblical Researches*, Rev. Dr. Rowland Williams; *The National Church*, Prof. Henry B. Wilson; *The Interpretation of Scripture*, Prof. Benjamin Jowett; *Tendencies of Religious Thought in England, 1688–1750*, Prof. Mark Pattison; *On the Study of the Evidences of Christianity*, Prof. Baden Powell; and *The Mosaic Cosmogony*, Charles Wycliffe Goodwin (layman).

ESSEG: see **ESZEK**.

ESSEN, *ĕs'sĕn*: town in Rhenish Prussia, between the Rhur and the Emscher, 20 m. n.e. of Düsseldorf, in a rich coal and iron district. The town is surrounded by the high chimneys of the steam-engines used in working the mines. As it has risen only very recently to its present importance, its architectural beauties are not great; it has, however, an imposing cathedral, containing many curious reliquaries, crosses, etc. E. owes its prosperity to the inexhaustible coal-mines in its vicinity, to which are due extensive works for all sorts of manufacture in iron. The enormous works of Herr Krupp, discoverer of the method of casting steel in very large masses, who employs about 20,000 men, are at E. At them are manufactured many articles for peaceful purposes, but the gigantic steel guns which the Germans used with such terrible effect at the siege of Paris (1870–1) have made the name of Krupp world-renowned. The annual production is about 330,000 tons of steel, and 26,000 tons of iron. Around the

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works of this great manufacturer quite a city has been formed. Largely through his liberality, excellent houses have been erected for the workmen, and are rented for a very moderate price. Churches have been built; schools of various kinds, including a work-school for women and an industrial school for girls, have been established; a public library is maintained; and places of amusement are provided. Aged employés are pensioned, free medical attendance is supplied for the sick, and hospitals have been erected for treatment of the injured. Fire and life insurances are provided at low rates, and the burdens brought by sickness are lightened by associated effort. There is also a system of practical co-operation through which the workmen obtain their food and other supplies at reduced prices. Thus, in various ways, the social life of the people is made pleasant, and their health and material prosperity are promoted. Although the industrial activity of E. is recent, the town itself dates from the foundation of the Benedictine nunnery 873. Pop. (1880) 56,944; (1890) 78,706; (1900) 118,862.

ESSENCE, n. *ĕs'sens* [F. *essence*—from L. *essentia*, the being of anything—from *esse*, to be: It. *essenzia*]: in *philosophy*, that which constitutes the particular nature of a being or substance; that without which a thing cannot be itself; existence; being; in *OE.*, cause of existence: used by modern writers generally as a synonym for *substance* (q.v.); yet these two words being often vaguely used, it is necessary to fix the author's meaning in each case. In *chem.*, etc., the concentrated preparation of any substance; a perfume; the virtues or qualities of a thing separated from its grosser matter; solutions of the essential oils in alcohol; prepared (1) by adding rectified spirit to the odoriferous parts of plants, or to the essential oils, and distilling; or (2) simply by adding the essential oil to the rectified spirit, and agitating till a uniform mixture is obtained. Thus the essence of lemons is merely a solution of the volatile oil of lemons in rectified spirit. ESSENCE D'ORIENT, n. essence of pearls; liquor prepared from a nacreous substance found in the scales of a fish called the bleak. It is used in the manufacture of artificial pearls. ESSENCE DE PETIT GRAIN, product of distillation from small unripe oranges about the size of a cherry; used as a perfume, like *Orange-flower water*. ESSENCE'D, a. -ĕnst, perfumed. ESSENTIAL, a. -sĕn'shăl, indispensably necessary; important in the highest degree; requisite; pure: N. existence; first principle; chief point; that without which the thing named is non-existent. ESSENTIALLY, ad. -shăl-lĭ. ESSENTIALNESS, n. state or quality of being essential. ESSENTIALITY, n. -shi-ăl'i-tî, state or quality of being essential; essential nature or character ESSENTIAL OILS: see OILS.

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ESSENES, n. plu. *ĕs-sĕnz'*: a scct among the anc. Jews, remarkable for their strict and abstemious life. ESSENISM, n. *ĕs'-ĕ-nĭzm*, the doctrines or the practices of the Essenes. This small religious fraternity among the Jews, are involved in obscurity as to their name and origin, as well as character and history. Still, in the wide field of the history of Semitic religions, few subjects have greater importance or interest. The Essenes bore one of the most momentous parts in the development of Judaism. Christianity stands in so close connection with them, that John the Baptist and Christ himself have been pronounced by some to have originally issued from their ranks. More surprising than all, out of Essenism, in the stage of Sabæism, has sprung Islam itself, and in this last development of its tenets and practices are still preserved some of its principal rites. It is but natural that from the days of the Fathers to our own, numberless writers, more or less qualified, should have endeavored to throw light on this mysterious brotherhood, but with results far from satisfactory, because of the obvious limitation of the sources which were consulted. Josephus, Philo, Pliny, Solinus, Eusebius, and the Fathers, generally, were considered the only sources, from which the genuine history of this fraternity could be deduced. Of these, Pliny indeed has a geographical notice, which cannot be traced to either Philo or Josephus; but the rest have so evidently derived their shallow and contradictory accounts indirectly, and through corrupted channels, from those two writers, that they lose all claim to consideration. Of the two books of Philo in which information regarding the Essenes is contained, one (*De Vita Contemplativa*) is proved to have been written about three centuries after Philo's death by a Christian monk as a panegyric on ascetic monachism. The other (*Quod Omnis*) is, to say the least, of doubtful genuineness, and is, moreover, at variance with Josephus. As to Josephus himself, it is now generally allowed that his Essenes stand in much the same relation to the historical Essenes as the ideal inhabitants of the *Germania* of Tacitus stand to the real Germans of his time. Strange that for so many centuries the real sources—the Talmudical writings—should not have been thought of. These, *together* with Josephus and Philo, Pliny, and the Arabians Macrisi and Abulfarag, will perhaps better enable us to form an idea, not only of the real state of this community, but, what is of no less moment, to trace the process by which they gradually arrived at their peculiar mode of life and worship.

Epitomizing facts and conclusions, we have to premise, that exception must be taken to the opening statement of Josephus, that there were three different 'sects' among the Jews: the Pharisees, the Sadducees, and the Essenes—a statement copied and accepted till the present day. The Sadducees were a political party, nothing more or less, and, as a matter of course, held religious views antagonistic to, or rather they did not accept the traditions of, their adversaries, the Pharisees, who, again, forming as they did, the bulk of the nation, cannot rightly be called a *sect*,

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Neither can the Essenes be called properly a sect; they were rather an inner circle or association within the wide national company of Pharisees. They were Pharisees of stronger convictions, and carried out the Pharisaic views with a consistency which made them ridiculous even in the eyes of their own mother-party (*Sota*, 26, a.); neither were they known by the names of Essenes, this being a very late designation, derived either from a Chaldee word *Sacha*, and meaning Bathers, or Baptists; or from *Asa*, meaning Healers. The Mishna, Beraitha, and Talmud speak of these advanced Pharisees in general as *Chasidim* (*Assidaioi*, Pious Men), *Nazirim* (Abstinent), *Toble Shacharit* (Hemero-baptists), *Banai* (Builders), and *Chaberim* (Friends). The Arabic book of *Maccabees* calls the Essenes simply *Assidaioi*, and Macrisi speaks of 'Nazirs, Essenes, and Baptists' as all being 'Asaniun,' or Essenes.

The Nazirhood, a kind of voluntary priesthood, enjoining abstinence from wine, flesh, and other sensual enjoyments, had in the troublous times of anti-Syrian agitation, and the general upheaving of society, found numerous adherents (*Tosifta Nazir*, c. 4; *Talm. Babli Berach.* 48, a 1; *Macc.* ii. 49; *Jos. Antiq.* xviii. 1); and gradually there sprang up contrary to the biblical example, which restricts this asceticism to a certain period) a host of men calling themselves 'Nazirs for ever'—*Nazire olam* (*Nazir*, 4, a.). Pharisees of a spiritual and contemplative bias, with no natural taste for the conflicts and activity of political or public life, or wearied, perhaps with the vanity of human aims, took this vow of Nazirship for life, and constituted themselves into a sort of religious club. Levitical purity in its strictest and highest sense made them draw closer and closer the innumerable '*fences*' which the traditional law had erected round the biblical law. Any one, friend or foe, could at any moment, by having touched something impure, disturb this purity for the time, and necessitate new and endless purifications. Thus it became necessary, or at least expedient, that those among them who could break all ties of friendship and family, should retire into a solitude not easily approachable by a stranger to their community. Food could not be prepared save by those of the brethren who knew and strictly obeyed the hyper-traditional injunctions. Their dress, every implement of daily use, had to be made under similarly stringent laws of purity. A natural consequence of this their exalted notion of outward priesthood, was—the different phases of woman's life taken into consideration—their general celibacy. (The explanation given by Josephus—The fear of the corruption of both towns and women—is entirely gratuitous, and utterly in discordance with the Jewish notions of the time.) In this state of voluntary isolation, trading was out of the question; they tilled the ground and lived on the fruits of the earth. Taking their meals, and these of the coarsest and plainest description, in common, they idealized the table into an altar, and, prayer having been said, they remained standing silently round it during the repast. That they had no individual property, follows of course,

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and their communistic motto, which the Mishna (Aboth) has preserved to us—‘Mine is thine, and thine is mine’—explains itself. We need not enlarge further on their small eccentricities—on the white linen garment, the apron (kenaphaim), the scoop or shovel; they, one and all, are signs and symbols of Levitical purity, the scoop reminding us of a certain Mosaic ordinance during the wanderings in the desert, the apron becoming necessary from the frequent ablution of their hands. Every morning, they bathed, like the priests who ministered in the temple, in pure spring water. They abhorred blood as a source of impurity, and for this reason, probably, some of them abstained also from going up to the temple, where sacrifices were daily offered; others are recorded as present at a festival in the temple (Succah, 51, 53). Their offerings were sent alive under the care of messengers. But these were but outward signs of purity, stepping stones to inner piety, to communion with God, which was to be acquired, according to their notion, only by solitude and an ascetic life. The belief in the efficacy of the most rigid simplicity and willing self-sacrifice, they held in common with the Pharisees; but their horror of oaths, their frequent prayers, their occupation with mystical doctrine, were their own. Untroubled by the noise of war or the strife of parties, leading a life divided between the bath, ablutions, contemplation, and prayer; despising the body and bodily wants; what more natural than that by degrees they should be led into a kind of mystical enthusiasm and fanaticism. They allegorized, they symbolized; and their efforts culminated in seeing the unseen. Absorbed in the attempt to fathom the mysteries of the nature of God one of their principal occupations was the study of the name of God; of that unpronounceable name which only the High-priest dared utter once a year in the Holy of Holies during the most awful and solemn service on the Day of Atonement. The knowledge of that name in four, in twelve, and in twenty-four letters, would give them the power of prophecy and of ‘receiving the Holy Ghost.’

Angelology, derived from the Magi, formed a prominent feature of their creed. In the course of time, they were viewed by the vulgar as saints and workers of miracles. A wonderful book of cures (*Sepher Refuoth*), which Talmudic, Arabic, and Byzantine authorities ascribe to Solomon, was in their hands, and with this, ‘by the aid of certain roots and stones,’ by the imposition of hands, and certain whisperings—a practice strongly condemned by the Pharisees (Synhedr. 90, a.)—they cast out demons and healed the sick. Philosophy they regarded so far only as it treated of the existence of God. Jehovali is the original light; from him proceed a number of spirits (the Platonic Ideas), and at their head stands the Wisdom, or *Logos*, into which, after death, the soul is again absorbed. Their code of Ethics was threefold—the love of God, of virtue, and of man; their scale of perfectibility reaching its acme in the communion with the Holy Ghost (*Ruach Hakodesh*), (Mishn. Sota, 99). In fine, mixing up, in the strangest manner, the most exalted and the most puerile notions, they became

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the forerunners of the Christian Gnostics and of the Jewish Cabbalists, and, it may be, of many secret, still existing orders, who may have derived from this source their ceremonies and the gradations of initiation.

They seem never to have numbered more than 4,000, including even those Nazirs or Essenes who remained in their own families. Their colony appears to have been established chiefly near the Dead Sea, and it is undoubtedly this colony which has served Josephus as a basis to his romantic Essene republic. But, however distant from each other they might be, a constant intercommunication was kept up through a body of delegates, or angels (*Malachim*). As they had sprung from the Pharisees, so they merged again into them—part of them, we should rather say; the remaining part became Therapeutæ, or Christians: see **THERAPEUTÆ: JEWISH SECTS**. The Talmud gives a distinct account of their ceasing to exist as a separate community (*Bechorot*, 27), and so soon after their extinction did they fall into oblivion, that in the third c. we find a Jewish sage asking who *these Hemerobaptists* had been (*Berachot*, 22, 1).

Much has been written and said of a certain literature which they possessed; on this we are without any trustworthy authority. One fragment only remains; it is quoted in the Talmud (*Jerusch. Berachoth. End*) in the following words: ‘It is written in the book of the *Chasidim*, If thou leavest it (the divine law) for one day, it will leave thee for two.’

In addition to the Talmud and Midrash, see Joseph *Antiq.* xv. 10, xviii. 1; *Jew. War*, ii. 7, 8; Philo, *Quod Omnis Prob. lib.* § 12; Plinius, *Hist. Nat.* v. 17; Epiphan. *Heres.* xxix.; Hieron., Cyrill., Chrysost., etc. Beckermann, *Ueber die Ess.* (1821); the histories of the Jews by Iost, Ewald; and Grätz; articles by Franckel; Sprenger’s *Leben Mohammad’s* (1861); Leutbecher’s *Die Essäer* (1857); the works of Reuss and Keim.

ESSENTIAL, etc.: see under ESSENCE.

ESSEQUIBO, ēs-sā-kē'bō: most westerly of the great rivers of British Guiana, rising in the Acarai Mountains, 41 m. n. of the equator, and after a course of 620 m. entering the Atlantic near the Venezuelan frontier, forming an estuary 20 m. wide, in which lie numerous fertile islands. The E. receives numerous large tributaries, as the Cuyuni and Mazaruni; on the Potaro, another affluent, is the magnificent Great Kaietur Fall, more than 700 ft. in sheer descent, discovered 1870. On the banks of the E. are forests of locust-tree, iron-wood, ebony, greenheart, and other fine timber trees, festooned with orchids, and laced together with lianas and other climbing plants. Beyond the forests are vast savannahs, formerly forests destroyed by fire, and now swamps of brushwood, reeds, and coarse grass. The E. is navigable for large ships to the first cataracts, about 60 m. from the sea. The county of E. has not prospered so much as Demerara and Berbice. Many of the old plantations are out of cultivation. Pop. 27,000, exclusive of 2,000 Indians.

ESSERA—ESSEX.

ESSERA, n. *ĕs'sĕr-a* [F. *esséré*; of Arabic derivation]: in *med.*, species of cutaneous eruption, consisting of small reddish tubercles over the whole body, accompanied by a troublesome itching. It ~~seems~~ to be a kind of lichen or urticaria.

ESSES, COLLAR OF: see SS, COLLAR OF.

ESSEX, *ĕs'ĕks*: maritime county of the s.e. of England, having the North Sea on the e.: the Thames estuary, dividing it from Kent, on the s.; Middlesex and Hertford on the w.; and Cambridge and Suffolk on the north.; greatest length from n.e. to s.w. 63 m., greatest breadth from e. to w. 54 m. It has 1,055,161 statute acres, nine-tenths being arable or in grass, and a twentieth in wood. The coastline is 85 m. long. Some cliffs at the Naze are 35 ft. high. The centre and north of the county are beautifully diversified and richly wooded, the highest point being Langdon Hill, 620 ft. above the sea. Besides the Thames, the chief rivers are the Stour, 50 m. long; Blackwater, 46 m.; Lea, Roding, Crouch, and Chelmer. The e. of the county is mostly on London clay, with limestone beds near Harwich. In the middle and north, there is much diluvium, with chalk fragments. Crag occurs near Harwich, and stones of phosphate of lime are found here and there. E. has few manufactures, except in the neighborhood of London, where are chemical works, tar, and other works of a kind that could not be carried on in a large scale within the metropolitan boundaries. The Thames Iron-work and Ship-building Company, near the new Victoria Docks, are another manufacturing feature of the county. At Colchester, is a great silk-mill, also at Bocking, Braintree, and Halstead. Tambour lace is made at Coggeshall and a few other places; there is straw-plaiting in some of the smaller towns, but the county has comparatively few distinctive manufactures. The chief crops are wheat, barley, oats, beans, potatoes, saffron, caraway, and hops. Great numbers of calves are fattened for the London market, and there are large sheep-flocks. E. has valuable oyster fisheries. Pop. (1881) 576,634; (1901) 816,503. The county is almost entirely in the diocese of Rochester. E. returns eight members to parliament. E. was once forest-land, and the seat of a powerful tribe, the Trinobantes, whose famous chiefs, Caractacus and Boadicea, were overthrown by the Romans. E. constituted part of the Roman *Flavia Cæsariensis*. It has afforded many Roman remains, and a Roman road once passed through Colchester, which was an important Roman station. The Saxon kingdom of E. included London and parts of Middlesex, Hertford, Bedford, and Essex.

ESSEX, ROBERT DEVEREUX, Earl of: 1567, Nov. 10—1601, Feb. 25; b. Netherwood, Herefordshire: son of Walter Devereux, first earl of E. He entered Trinity College, Cambridge, at the age of ten, where he remained for four years. Lord Burleigh, to whose guardianship he had been intrusted, introduced the handsome and gifted youth at court 1584. Here, by his agreeable manners, his appear-

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ance, and talents, he established himself among troops of friends, and gained the special favor of Elizabeth. In 1585, he accompanied the Earl of Leicester to Holland, where he distinguished himself at the battle of Zutphen, and on his return to England was made master of the horse and knight of the Garter. After the death of Leicester, E. continued to rise in the favor of Elizabeth, who loaded him with honors. In 1591, he commanded the forces sent to the assistance of Henry IV. of France against the Spaniards, but achieved no success. The next few years were spent in endeavoring to get the better of Burleigh—the wisest, the most prudent, and the most politic of all Elizabeth's advisers. In 1596 E. was appointed joint-commander with Lord Howard in the expedition against Spain, to which Burleigh was strongly opposed; and though E. displayed all his wonted courage, and contributed to the capture of Cadiz, which caused immense loss to the Spaniards, yet the expedition resulted in nothing, and E. had to defend himself against various accusations on his return. In 1597, he was made earl marshal of England, and, on the death of Lord Burleigh, chancellor of Cambridge. In 1598 occurred the first fatal mistake in E.'s career. Presuming upon Elizabeth's admiration and feminine fondness for his person, he differed from her about some trifling matter, and angrily and rudely turned his back upon her in the presence of some of the council, and her majesty, whose language was hardly more delicate than her father's, gave him a vigorous box on the ear, telling him to 'go and be hanged.' A violent quarrel ensued, which, though apparently smoothed up, was never really so. E. was afterward, 1599, sent to Ireland—part of which at that time was in a state of rebellion—as lord-lieut. of that country; but here his government was ill-advised and ineffectual, and after a few unimportant undertakings, he concluded a truce with the rebels, which was regarded at court as high treason. To confront his enemies, he hastened back to London, contrary to the queen's express commands, and forced his way into Elizabeth's bedchamber. Justly offended, the queen deprived him of his dignities, and commanded that he should be called to account for his behavior. E., advancing from one degree of foolhardihood to another, tried to excite an insurrection in London. He was imprisoned, tried, and found guilty. Elizabeth long delayed signing the warrant for his execution, in the hope that he would implore her pardon. He was beheaded, after defending himself with pride and dignity. E. was rash, bold, and presumptuous; but brave, generous, and affectionate, and the friend and patron of literary men.

ESSEX, *ĕs'sĕks*. ROBERT DEVEREUX, Earl of: 1591–1646, Sep. 14; b. London; soldier. When 11 years old he was restored by James I. to the rank and titles held by his father, the second earl, and became a companion of the young Prince of Wales; and when 15 years of age was married to Frances Howard, daughter of the Earl of Suffolk and a year his junior, from whom he was divorced

PLATE 5.

Esparto
Esquimaux



Esquimaux Winter Station, Greenland.



Esparto Grasses.—1, *Stipa tenacissima*; 2, Fruit of ditto; 3, *Lygeum Sparsum*; 4, Flowering stem and (5) fruit of ditto.

ESSEX—ESTABLISH.

1613. He served in the army of the elector palatine in Holland 1620-23, was vice-admiral of an unsuccessful naval expedition against Cadiz 1625, and was lieut.gen. of an army sent by King Charles against the Scotch Covenanters 1639. Espousing the cause of the parliament against the king, he was appointed to the command of the parliamentary army at the beginning of the civil war, was victorious over Charles at Edgehill 1642, captured Reading 1643, and relieved Gloucester, but lost the greater part of his army 1644. He urged the impeachment of Cromwell before the house of lords, 1645, when Cromwell forced the adoption of the ‘self-denying ordinance,’ and E. had to resign his commission. An annuity of £10,000 was settled on him for life.

ESSEX, THOMAS CROMWELL, Earl of: see CROMWELL, THOMAS.

ESSEX EMERALD, n.: a geometer moth, *Geometra smaragdaria*.

ES-SIOUT: see SIOUT.

ESSLINGEN, *ĕs'ling-ĕn*: manufacturing town of Germany, kingdom of Würtemberg; near the right bank of the Neckar, in the centre of a pleasing and fertile district, seven m. e.s.e. of Stuttgart. It consists of the town proper, and five suburbs, and is surrounded by strong walls, and fortified by towers. The chief buildings are the *Frauenkirche*—a splendid edifice in the purest Gothic style, built 1440, surmounted by a spire 230 ft. high—the old and new town-house, and the old castle. It has the greatest machine-making trade of the kingdom, has manufactures of a wine called, E. champagne, of woolens, and cotton and woolen yarns, lacquered iron, silver-plate and tin wares, and paper, with good trade in wine and agricultural produce.—E. was founded in the 8th c., and received 1209 the rights of a free city of the German empire. The long and bloody quarrel between it and the House of Würtemberg ended at the peace of Lunéville (1802), when E., with its territory, was assigned to the duchy of Würtemberg.—Pop. (1880) 20,758; (1890) 22,156; (1900) 27,325.

ESSOIN, or Essoign, n. *ĕs-soyn'* [OF. *essoīn*—from mid. L. *exōniūm*, business, occupation, an excuse for non-fulfilment of duty]: in *OE.*, a lawful excuse for an absent person, or for the absence of a person summoned to appear in court; a good cause of discharge for an impotent person.

ESSONITE, n. *ĕs'son-īt* [Gr. *hēssōn*, lower, less, because less hard than zircon, idocrase, etc., which it resembles]: in mineral., cinnamon stone; cinnamon colored or yellow variety of grossularite or wilnite, which is a variety of garnet. E. is from Ceylon.

ESSORANT, a. *ĕs'so-rant* [F. *essor*, the soaring of birds]: in her., term applied to a bird represented with its wings half open as though preparing to take flight.

ESSOUAN', or ESWAN': see ASSOUAN.

ESTABLISH, v. *ĕs-tăb'lish* [E. *établir*, to establish: F. *établissant*; OF. *establisant*, establishing: OF. *establir*—

ESTABLISHED CHURCH.

from L. *stabiliſ*, that stands fast, firm]: to settle or fix firmly; to found permanently; to make firm; to constitute; to decree; to ratify. ESTAB'LISHING, imp. ESTAB'LISHED, pp. *līſt*: ADJ. settled firmly, as by law. ESTAB'LISHER, n. one who. ESTAB'LISHMENT, n. the act of establishing; a household; settlement; income; a place of trade; that which is fixed or set up perinantly; a form of religion supported by, and in connection with, the state. ESTAB'LISHMENT OF THE PORT, a term employed to denote the interval between the time of high water at any given port, and the time of the moon's transit immediately preceding the time of high water, when the moon is at the new or full moon.—SYN. of 'establish': to confirm; fix; settle; institute; found; erect; set up; enact; ordain; uphold.

ESTAB'LISHED CHURCH: church established and maintained by a state for the teaching of Christianity in a particular form within its boundaries. Subsequent to the Reformation, many of the opinions which had given sanctity to the Church of Rome still kept possession of men's minds; among these was the notion, that the civil government of each state was bound to maintain a particular form of Christianity. The same fallacious reasoning which in more recent times has led to the search for one absolutely best form of civil government was at work then with reference to the church. The Rom. Cath. Church was not the best form—of that the Prot. states had become convinced—but all forms were not therefore indifferent; and if one was better than another, and another better than that, there must be an absolutely best, which the state was bound to discover, and when discovered, to substitute for that which had been abolished. The idea that the good or bad qualities of forms of government, whether civil or ecclesiastical, so long as they did not violate the fundamental doctrines of Christianity or morality, were relative, and not absolute, and that whilst one might be the best for men in one stage of development or of one particular temperament, another form might be the best for others, did not belong to that age. Each Prot. state consequently established a church, conformity to the tenets of which it enforced, not only upon those who as ministers were henceforth to enjoy the property which in Rom. Cath. times had been devoted to the spiritual interests of the community, but very often on its own civil servants and advisers. The benefit of the arrangement was, that, to a greater or less extent, the means which the community had set apart for its own spiritual improvement were protected from the spoliation of private individuals; and this benefit was secured more effectually the more completely the new church took the place of the old—in England, for example, better than in Scotland; but as each of the Prot. states had substituted one form of church-govt. for another, and as the same form had not been adopted by them all, the idea of there being one form which was absolutely preferable to the others, though not abolished, was rudely shaken. In England, Queen Elizabeth had stated in her celebrated declaration, that she, as head of the church, 'would not endure any varying or departing in the

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'least degree' from the doctrines of the Episcopal Church of England as set forth in the Thirty-nine Articles; and yet Presbyterianism was established in England 1649. In Scotland, where Presbyterianism had at first taken root, Episcopalianism had more than once become the law of the land. The effect of such occurrences was to counteract the belief in any one form as the form for all Christendom, and to facilitate dissent and the formation of sects. The pastors of these sects were not at first recognized by the law as entitled to any of the privileges of Christian ministers. Whatever they might be to their own flock, to the state they were laymen, and their churches were mere secular lecture-rooms, or, at most, places of meeting for private devotion: see *NONCONFORMISTS*: *DISSENTERS*: *CHURCH: ETC.* Gradually this view became modified, and the civil consequences attaching to sacred rites, when performed by a clergyman of the establishment, were extended to them when performed by dissenters: see *MARRIAGE*. But though many of the privileges, and all the liberties belonging to the established church, have now been extended to dissenting bodies, including Rom. Catholics (see *ROMAN CATHOLIC EMANCIPATION*) and Jews (see *JEW*), the established churches of England and Scotland are supported by the state, and guarded from spoliation by the coronation oath (q.v.). The grant to the Rom. Cath. college of Maynooth, and the *Regium Donum* (q.v.) to the Presb. ministers in Ireland, were capitalized by the act (1869) which disestablished the Irish Church. There is no endowment to other religious denominations, as in France; and the emoluments of the established church in England, though modified in their distribution by the labors of the Ecclesiastical Commissioners (q.v.), have not yet been appropriated to any other religious uses than these in connection with that church.

The cause of established churches is very generally maintained on the ground of the alleged duty of the state to provide for the religious instruction of the whole body of the people, as most essential to their moral welfare and so to the general prosperity of the community. It is further argued, in support of the same cause, that civil rulers, or the people as associated in a free state, are under a moral obligation of the highest kind, to acknowledge God, his law, and his ordinances. Concerning these and other arguments, for and against established churches, see the article *VOLUNTARYISM*. It may here, however, be observed, that the arguments just mentioned do not necessarily infer, even when admitted to the utmost, that the state is bound to support in any exclusive way a particular sect or denomination, unless, on the further assumption that religious truth and worth belong to that denomination alone. Nor does the *endowment* of a church by the state necessarily follow from the fullest adoption of the principles thus contended for. Yet, on the other hand, it is a point which may very reasonably be disputed, how far the common arguments against state endowments are applicable to those endowments not originally bestowed by the state, but which the state has, from a very early period, recognized as be-

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longing to the church; a description which will be found to comprehend great part of the existing endowments of established churches. The exclusive possession of them by a particular denomination, and their rightful mode and sphere of appropriation to religious uses, are, however, distinct questions.

ESTACADE, n. *ĕs'ta-kăd* [F.]: in *fort.*, a line of stakes in water or swampy ground to check the approach of an enemy.

ESTAFET, or ESTAFETTE, n. *ĕs'tă-fĕt'* [F. *estafette*—from *stafetta*]: in *Europe*, one of a series of couriers in relay; an express for conveyance of letters and small packages.

ESTAING, *ĕs-tăng'*, CHARLES HECTOR, Comte d': 1729–1794, Apr. 28; b. Auvergne, France: army and navy officer. He entered the French army as col. of inf.; was promoted brig. gen. 1757; accompanied the expedition of Comte de Lally to the E. Indies; and was captured at the siege of Madras, 1759. He was released on parole, and without awaiting exchange, took command of several men-of-war and greatly harassed the English in various parts of the East. On his return to France, 1760, he accidentally fell into the hands of the English, and, being charged with breaking his parole, was imprisoned sometime in Portsmouth. In 1763 he was appointed lieut. gen., and 1777 vice-admiral in the French navy. In 1778, in accordance with the treaty between France and the United States, France fitted out a fleet of 12 ships of the line and 4 frigates to aid the latter in the struggle against Great Britain, and E. was placed in command. He sailed Apr. 13, reached Del. bay in July, and then proceeded to New York, expecting to encounter the British fleet on the way. He captured some prizes off the coast of N. J.; agreed to assist in a land and sea attack upon Newport to expel the British from R. I.; reached the harbor late in July; and hearing of the approach of a fleet put to sea to meet it. He was overtaken by a severe storm which caused him to put into Boston for repairs, and the projected attack failed. Subsequently he captured St. Vincent and Grenada, W. Indies; and 1779, Oct. 9, coöperated with Gen. Lincoln in an ineffectual attempt to capture Savannah, Ga. He returned to France 1780; commanded the allied fleets of France and Spain 1783; was elected to the assembly of nobles 1787; appointed to the command of the national guard 1789; chosen admiral of the navy 1792; testified in favor of Marie Antoinette at her trial 1793; and despite his eminent military and naval services to France was condemned as a royalist and guillotined.

ESTANCIA, n. *ĕs-tăñ'să-ă* [Sp. a mansion]: in *S. Amer.*, an estate; a farm.

ESTATE, n. *ĕs-tăt'* [F. *état*; OF. *estat*—from L. *status*, state, position]: condition of a person or thing; rank; landed property; property in general; orders or classes of men in a country; dominions or possessions: V. in *OE.*, to settle, as a fortune. ESTATES, n. plu. *ĕs-tăts'*, in *Scrip.*, persons of high rank; in *Scot. hist.*, the house of parlia-

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ment. **ESTATE-REAL**, lands and tenements. -**PERSONAL**, movable property. -**TAIL**: see **ENTAIL**.—**THREE ESTATES OF THE REALM**, in *Britain*, the three branches of the legislature, the lords spiritual, the lords temporal, and the commons of Britain and Ireland (not, as popularly believed, the sovereign, lords, and commons): see **STATES**. **FOURTH ESTATE**, a name popularly and familiarly applied to the newspaper-press; journalists.

ESTATE, in Law: in its widest sense, property, both real and personal; but technically, the measure of a person's right to, or interest in, real property. The division of property into real and personal grew out of the nature of the remedies necessary to reinstate an owner who had been deprived of either, and may be traced to ideas borrowed from the Feudal law. Land itself is always viewed as real estate; but other things are classed among real or personal property, according to the intent with which they have been annexed to land and to a certain extent according to the manner in which the annexation has been made. Sometimes, however, by force of an equitable doctrine under which whatever is agreed to be done is regarded as done, things in no way physically attached to land may for the purpose of doing justice be regarded as land. A familiar instance of the application of this principle is the case of money directed by will or agreement to be laid out in land. Such money is considered land. And conversely, if land is directed to be converted into money, all the attributes of personal property may attach to such land. Estates may in the first instance be divided into legal and equitable. By the former is meant the estate which a person has at common law, by the latter an interest created by or enforceable in a court of equity: see **EQUITABLE ESTATES**: **USES**: **TRUST**. Legal estates may be considered with reference to the quantity of the estate, the time of enjoyment, and the number of persons who may unite in the enjoyment. Under the first division, estates are either freehold or less than freehold. Freehold estates, again are divided into freeholds of inheritance or fees (q.v.), and freeholds not of inheritance, or for life. An estate for life may be for the life of the person to whom it is granted, or for that of another person, or for more than one life. A person holding an estate for the life of another is called tenant *per antre vie*. An estate *per antre vie*, being a freehold, descends in case of the death of the tenant during the term to his heir, and not to his executor. See **COURTESY**, in Law: **DOWER**. Estates less than freehold are also called chattels real, and on the death of the tenant pass to his executor. They are divided into estates for years, estates at will, and estates on suffrage. See **LEASE**. With reference to the time of their enjoyment, estates may be divided into estates in possession or in expectancy. An estate in possession comprehends not only an estate in the actual occupation of the tenant but one from which he may have been wrongfully ousted. An estate in expectancy may be either in reversion or remainder: see **REVERSION**: **REMAINDER**. With reference to the number of persons entitled to the enjoyment, estates may be in severalty, in joint

ESTE.

tenancy, in coparcenary or in common. An estate in severalty, is where the sole right to the estate is in a single person. See JOINT TENANCY: COPARCENARY: TENANCY IN COMMON: also ESTOVER: EMBLEMENTS: WASTE; CHATTEL: RIGHT OF ENTRY.

ES'TÉ (ancient *Ateste*): town in the Italian province of Padua, on the s. slope of the Euganean Hills, 17 m. s.s.w. of Padua. It is an old town, and has a decidedly Lombard appearance, many of the houses being supported by arches. It has several interesting buildings, among which the chief are the *Rocca*, or castle of E., with a grim donjon tower, overhanging the town, and the church of *San Martino*, in Romanesque style, surmounted by a campanile, which slopes as much as the Leaning Tower of Pisa. Both church and tower have been sadly disfigured by an attempt to modernize them. E. manufactures silk goods, saltpetre, hats, and earthenware and has numerous silk-mills and whetstone quarries in the vicinity. Pop. about 6,000.

ES'TÉ: one of the oldest and most illustrious families of Italy, which, according to the historian Muratori, owed its origin to those petty princes who governed Tuscany in the time of the Carlovingians, and who were in all probability of the race of the Longobards.—The first whose figure is more than a mere shadow is Adalbert (died about A.D. 917).—The grandson or grandnephew of Adalbert, named Oberto, was one of the Italian nobles who offered the crown of Italy to Otho of Saxony. He is afterward styled *comes sacri palatii*, and appears to have been one of the greatest personages in the realm; he married a daughter of Otho, and died about 972.—In later times, the family of E. received from the emperors several districts and counties, to be held as fiefs of the empire. The family divided, at an early period, into two branches, the German and Italian. The former was founded by Welf or Guelfo IV., who received the investiture of the duchy of Bavaria from Emperor Henry IV. 1070. The houses of Brunswick and Hanover, and consequently the sovereigns of Great Britain, called also Este-Guelfs, are descended from this person. In the 12th, 13th, and 14th c., the history of the E. family, as heads of the Guelf party, is interwoven with the destinies of the other ruling families and small republics of n. Italy. During this period they gained possession first of Ferrara and the march of Ancona (1208), afterward of Modena and Reggio (1288-9), and were widely celebrated as the patrons of art and literature.—One of the most illustrious was Azzo VII., who encouraged Provençal troubadours to settle at his court at Ferrara, and founded schools in that city.—Alfonso I. (died 1534) was distinguished equally as soldier and statesman, and was celebrated by all the poets of his time, particularly by Ariosto. His second wife was the notorious Lucrezia Borgia. His quarrel with the Popes Julius II., Leo X., and Clement VII., was unfortunate, as an interdict was laid upon him for his adherence to the league of Cambray, and his papal fiefs declared forfeited. After the siege of Rome, 1527, the duke was restored to his former possessions by Charles V.—His suc-

ESTEEM—ESTELLA.

cessor, Ercole or Hercules II., who married Renate, daughter of Louis XII. of France and Anne of Brittany, attached himself to Charles V. He and his brother, a dignitary of the Rom. Cath. Church, were also liberal patrons of art and science; the latter erected the magnificent Villa d'Este at Tivoli—The next prince, Alfonso II. (died 1597), would have been not inferior to the preceding but for his immoderate love of splendor, his inordinate ambition, and his cruelty toward the poet Tasso, whose eccentricities, however, it must be confessed, were enough to try the patience of any man.—Alfonso IV. (latter half of the 17th c.) was very fond of the fine arts, and founded the Este gallery of paintings.—RINALDO (died 1737), by his marriage with the daughter of the Duke of Brunswick-Lunenburg, united the German and Italian houses, separated since 1070.—The male line of the house of E. became extinct on the death of Ercole III. 1803, his possessions having been previously seized by the French invaders, and annexed to the Cisalpine Republic. His only daughter married the Archduke Ferdinand, third son of Francis, emperor of Austria.—Their eldest son, Francis IV., by the treaty of 1814–15, was restored to the territories which had belonged to his maternal ancestors, comprising the duchy of Modena; and, on his mother's death, obtained the duchies of Massa and Carrara.—He was succeeded by his son, Francis V., 1846, Jan. 21.—The connection which the family of E., like others of the small Italian principalities, had formed with Austria, gave it pro-Austrian sympathies, the result of which has been fatal to its popularity and dynastic existence. In 1860, the sentiment of Italian unity and independence, which for the previous 15 or 20 years had been steadily fostered by the policy of Sardinia, triumphed in a universal explosion of national feeling, which united the peninsula (with the exception of Rome and Venice) under the authority of Victor Emmanuel. Venice was added to the kingdom of Italy 1866, and Rome became the capital 1870.

ESTEEM, v. *ēs-tēm'* [F. *estimer*, to esteem—from L. *aestimō*, I set a price upon; It. *estimare*]: to set a high value upon; to prize; to regard with respect or friendship; to think; to hold in repute: N. a high value set upon; respectful or reverential regard; in *OE.*, estimate; reckoning. ESTEEM'ING, imp. ESTEEMED', pp.-*tēmd'*. ESTEEM'ABLE, a. -ā-bl, that can or may be esteemed. ESTEEM'ER, n. one who. ESTIMABLE, a. *ēs-tī-mā-bl* [F.—L.]: that can be estimated or valued; worthy of esteem or honor; deserving regard; valuable. ES'TIMABLY, ad. -bli. ES'TIMABLENESS, n. -bl-nēs.—SYN. of 'esteem, v.': to value; respect; revere; reverence; regard; estimate; appreciate; reckon.

ESTELLA, *ēs-tēl'yā*: ancient city of Spain, province of Navarre, pleasantly situated on the left bank of the Ega, about 27 m. s.w. of Pamplona. It is a well-built, clean town, with several squares, and has, in the environs, a variety of agreeable promenades and pleasure-grounds. It has two interesting churches, both old, and one of them,

ESTERHAZY—ESTHER.

San Juan, a fine building with a very lofty tower. The manufactures are woolen and linen fabrics, brandy, and earthenware. A moderately good wine is made in the vicinity. E. has some trade in fruits, wool, hardware, and grain. Here Don Carlos was proclaimed king 1833, Nov.; and at E., again become a Carlist stronghold, battles were fought 1874 and 5. The city was taken by the govt. troops 1876. Feb.—Pop. abt. 7,000.

ESTERHAZY, *ĕs-tér-há'zĕ*: ancient Hungarian family, afterward raised to the rank of princes of the empire, the representative of which is at present the richest landed proprietor in Austria. The family divided into three main branches—the Esesznek, Altsohl or Zolyom, and Forchtenstein lines.—A descendant of the last family, **NICHOLAS D'E.** (b. 1765), travelled over a great part of Europe, and resided for a considerable time in England, France, and Italy. He founded the splendid collection of pictures at Vienna. He also made a choice collection of drawings and engravings. When Napoleon, 1809, entertained the notion of weakening Austria by the separation of Hungary, he made overtures to Prince E. respecting the crown of Hungary, which, however, were declined. The great Haydn composed most of his works at the court of Prince Nicholas.—His son, **Prince PAUL ANTON D'E.** (1786–1866), entered at an early age on a diplomatic career. After the peace of Vienna, he went as ambassador to the court of Westphalia. From 1815 to 18, he represented the Austrian govt. at London. He filled the same office 1830–38, and distinguished himself by diplomatic tact and ability. In 1843, he returned home, and continued to exert himself in the cause of political and literary progress. In 1848, Mar., he became minister of foreign affairs, in the cabinet presided over by Batthyani; but when the struggle between Austria and Hungary broke out, he exhibited more prudence than heroism by retiring from public affairs altogether. The hereditary prince, **NICHOLAS PAUL CHARLES E.** (b. 1817, June 25), married Lady Sarah Villiers, daughter of the Earl of Jersey.

ESTERHAZY, **MARIE CHARLES FERDINAND WAL-SIN**: forger; b. 1847, Dec. 16; entered the French army; promoted lieut., 1878; capt., 1879, and eom. (major in other armies), 1892; retired from army, 1897, owing to ill health. Became widely known in connection with trial of Capt. **ALFRED DREYFUS** (*q. v.*), whom he accused as being writer of the *borderéau*, which it was alleged showed that Dreyfus had divulged French military secrets to German authorities. Col. Piequart, chief of Intelligence Bureau of War Office, made discoveries, 1896, which indicated that the *borderéau* was written by Esterhazy, who had forged Dreyfus's handwriting. On further investigation Dreyfus was given a new trial, and though again convicted, much evidence pointed to Esterhazy. So strong did this opinion become that E. was compelled to leave France.

ESTHER, *ĕs'tér* (signifying ‘the planet Venus’): is the Persian name of Hadassah, daughter of Abihail, the son of

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Shimei, the son of Kish, a Benjamite. She is represented in Scripture as an orphan, and as having been brought up by her cousin Mordecai, officer in the household of the Persian monarch Ahasuerus. Her history, in the Book of Esther, is extremely interesting. When the misconduct of Vashti had cost her her 'royal estate,' all 'the fair young virgins' of the kingdom were gathered together, that Ahasuerus might choose a successor. He selected Hadassah, who received the name E. for her loveliness. The great event of her life was the saving of her Jewish countrymen from the horrors of that universal massacre planned by the malice of Haman, and consented to by the thoughtless cruelty of an oriental despot. E.'s success was signal; and the feast which she and her cousin Mordecai appointed in memory of their deliverance—viz., the feast of Purim (i.e., of Lots), is, in consequence, celebrated to this day with great enthusiasm. E. is not mentioned in profane history, whence it has been inferred by some that she was not exactly the *wife* of Ahasuerus (Xerxes), but rather the favorite of his harem, to which she undoubtedly belonged; for, as we read (ii. 8), E. was consigned 'to the custody of Hegai, keeper of the women. This hypothesis perhaps gains probability from the fact, that the Persian kings did not choose wives from their harem, but from the principal Persian families, or from the daughters of foreign potentates.

ESTHER, Book of: one of the very latest of the canonical books of the Old Testament, and commonly, but without a shadow of evidence, supposed to be written by Mordecai or Ezra. This is the view of Abenesra, Clement of Alexandria, Augustine, Gerhard, and others. The Talmud assigns the authorship to the members of the Great Synagogue, a semi-mythical body, used by Jewish rabbis and Christians divines as a sort of *Deus ex machina* to solve every difficulty. According to the opinions of the most learned and unprejudiced critics the date of its composition must be placed after the downfall of the Persian monarchy. The language is much later than that of Ezra, and Nehemiah, and the fact of occasional explanation of Persian customs fits the period of the Seleucidæ better than an earlier one. The Hebrew text is that which has been followed in the English version; but the Septuagint is full of late interpolations and additions by Alexandrian Jews. The book is held in the highest reverence by the Jews; so much so, that Maimonides declared that, in the days of the Messiah, every Jewish scripture would be forgotten except the book of Esther and the Pentateuch. The book is not written in a theocratic spirit, like the rest of Jewish literature. Nothing is directly attributed to God; in fact, his name is not mentioned. Neither is there the remotest trace of religious feeling of any kind. Luther, in his usual off-hand way, expressed his contempt for the book, in spite of the admiration which the Jews bestowed on it, censuring it for its 'heathenish extravagance,' and declarat. that, in his judgment, it was 'more worthy than all of being excluded from the canon.' The absence of all recognition of God, perplexed some of the ancient Jewish,

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commentators, who therefore invented the hypothesis, that the book was originally a part of the Persian chronicles, probably executed by Mordecai. The hypothesis that it is a Persian chronicle, is by many late Christian scholars accepted as solving many difficulties. On this theory, this book has its place in the Bible by divinely inspired direction, as had the decrees of Nebuchadnezzar, Cyrus, and Darius. It is inserted as showing God's interposition by His providence to save the race of Israel from extinction, so that from it might come, according to the flesh, the promised Christ.

The *Apocryphal additions* to E. consist of six important passages, found neither in the Hebrew nor in the Chaldee, translated by Jerome into Latin, and printed in later editions of the Vulgate without his explanations. In the later form they are found in the English version of the Apocrypha.

ESTHERIA, n. *ĕs-thĕr'ĭ-a* [an anagram for *Theresia*]: genus of crustaceans, order *Phyllopoda*, family *Limnadiadæ*. The body is protected by a bivalve carapace, with concentric lines of growth, the two bivalves of which are united at their beaks, though they have not a ligament. Twenty-four recent species have been discovered, all inhabitants of fresh or of brackish water, not one marine. Till 1856, the carapace of Estheria found in the Old Red Sandstone of Scotland was believed to be the bivalve shell of a small marine mollusk *Posidonomya minuta*. The discovery in that year by T. Rupert Jones that it was probably crustaceous and from fresh or brackish water was one reason for abandonment of the old view that the Old Red Sandstone of Scotland was marine. Estheria has been found in England, Scotland, and Ireland, in France, Germany, Russia, N. America, and Central India.

ESTHESIOMETER, n. *ĕs-thĕ-si-ōm'ĕ-tĕr* [Gr. *aisthēsis*, perception, sensibility; *metron*, a measure]: in *surg.*, an instrument to ascertain the tactile sensibility of the human body. It has two points, adjustable as to distance, and the object is to ascertain the greatest proximity at which the points give distinct sensations. The result is indicative of normal or abnormal condition of the surface.

ESTHETICS: see *ÆSTHETICS*.

ESTHONIA, *ĕs-thō'nī-ă*, called by the inhabitants *Wiroma* (i.e., the Border-land): Russian government, one of the Baltic Provinces (q.v.). It extends immediately s. of the Gulf of Finland; 7,787 sq. m. It was conquered (1182–1241) by the Danes, who sold it to the Teutonic knights 1346. It came into the possession of the Swedes 1561, but was taken from them by Peter the Great 1710; and by the treaty of Nystadt was finally secured to Russia 1721. One-third of the entire surface, which is in general flat, is under cultivation, and produces great quantities of rye and barley; the remaining two-thirds are chiefly sandy tracts and marshes, strewn in many places with large blocks of granite; there are also extensive forests of birch and

ESTHS—ESTOPPEL.

pine. The govt. of E. is divided into four circles; its principal town is Reval or Revel (q.v.).

The inhabitants are divided into Estlanders and Esths. The former are a mixture of Swedes, Germans, and Russians, and comprise the nobles and the town-populations. The latter belong to the Finnish race, and are the original possessors of the soil. Their language is soft and musical, and is divided into two leading dialects, that of Revel and that of Dorpat. They possess a literature rich in splendid national songs. See Neus. *Esthnische Volkslieder* (Reval, 1850-1). They are industrious, kind-hearted, and in the main religious and attached to the Prot. doctrines. A great part of Livonia is peopled with Esths, the entire number of whom in all the Baltic provinces is about 650,000.—Pop. of E. (1880) 353,103; (1889) 392,738; (1897) 413,724.

ESTHS, n. plu. *ěsts*, or ESTHONIANS, n. plu. *ěs-thō'ni-ānz*: a people s. of the Gulf of Finland, allied to the Finns: see ESTHONIA.

ESTIENNE, or ETIENNE: see STEPHENS (family of printers).

ESTIMATE, v. *ěs'ti-māt* [L. *aestimātus*, valued, rated (see ESTEEM)]: to form an opinion of the value of or expense of; to fix the value by comparison and from experience; to calculate: N. the computed cost of anything; a valuing or rating by the mind; a valuation. Es'TIMATING, imp. Es'TIMATED, pp. Es'TIMATOR, n. -*ter*, one who. Es'TIMA'TION, n. *-māshūn* [F.—L.]: an opinion or judgment of the value or worth of; esteem; regard; favorable opinion. Es'TIMATIVE, a. *-mā-tīv*, able to estimate or judge.—SYN. of 'estimate, v.': to appraise; value; appreciate; prize; rate; number; count; esteem; judge; compute; regard; honor.

ESTIVATION, ESTIVAL: see ÆSTIVATION.

ESTOC, *ās-tok'* [Italian]: small dagger worn at the girdle, called in Elizabethan times a tucke.

ESTOILE, *ās-toyl'*, or STAR, in Heraldry: charge, differing from the mullet (q.v.) by having six waved points; the mullet consisting of five plain points: see MULLET.

ESTO PERPETUUM, *ěs'tō pēr-pēt'ū-ūm*, or ESTO PERPET'UA, *-pēt'ū-a* [L.]: may or let it be perpetual or forever.

ESTOPPEL, n. *ěs-tōp'ěl* [OF. *estouper*, to stop]: in law, impediment, or bar to a right of action, arising from a man's own act. It is called an estoppel or conclusion, because a man's own act or acceptance stoppeth or closeth up his mouth to allege or plead the truth.—*Co. Litt.* 352 a. Estoppels are of three kinds—1. By matter of record, where any judgment has been given in a court of record, the parties to the suit are estopped from afterward alleging such matters as would be contradictory to the record. 2. By matter in writing. Thus, a party who has executed a deed is precluded from afterward denying, in any action brought upon that instrument, the fact of which it is evidence. 3. By matter in *pays*, as by livery, by entry, by acceptance of rent, etc.—by any of which acts a man is

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barred from pleading anything to the contrary. The principle of estoppel is that what a man has once solemnly alleged is to be presumed to be true, and therefore he should not be suffered to contradict. The doctrine of estoppel prevails in the United States and England; also in Scotland, under the name of personal exception (q.v.). ESTOR, v. *ēs-tōp'*, to bar; to place under estoppel. ESTOP'PING, imp. ESTOPPED, pp. *ēs-tōpt'*.

ESTOUFADE, n. *ēs-tō-fād* [F. *étouffade*—from OF. *estouffer*; F. *étouffer*, to stuff]: in *cook.*, a mode of cooking meat slowly in a closed vessel.

ESTOVER, n. *ēs-tō-vēr* [OF. *estoveir*, to be needful]: in *law*, supply of needful wood for repairs, fuel, etc.; an incident to the estate of a tenant for life or for years. It is the right which the tenant has to make use of the wood on the estate for certain definite purposes. Estovers, or *botes* (Saxon), are of three kinds—house-bote, which is twofold—viz., *estoverium adificandi et ardendi*, a right to wood for fuel and repairs of the house, plowbote, *estoverium arandi*, wood for plows and carts; and haybote, *estoverium claudendi*, wood for repairing hedges and fences.—*Co. Litt.* 41 b. E. is used sometimes also to denote an allowance of food and clothes.

ESTRADE, n. *ēs-trād'* [F.]: a level place; the raised part of the floor of a room.

ESTRANGE, v. *ēs-trānj'* [F. *étranger*, a foreigner: OF. *estrange*, strange—from It. *estraneo*, not native, foreign—from L. *extrānēus*, what is without, a stranger]: to divert from its original use; to alienate; to turn from kindness to indifference or enmity; to withdraw the heart or affections from. ESTRAN'GING, imp. ESTRANGED', pp. *-strānj'd'*. ESTRANGE'MENT, n. *-mēnt*; the withdrawal of the heart or affections from; alienation.

ESTRANGELO, n. *ēs-trāng'gēlō* [*e*, not: Gr. *stronggulos*, smooth or even]: a variety of the old Phœnician alphabet, whose characters are heavy and cumbrous; said also to be derived from two Arabic words, signifying ‘writing of the Gospel.’

ESTRAPADE, n. *ēs-trā-pād'* [F. a species of torture]: the violent jerking of the hind legs which a horse makes when desirous of getting rid of his rider; also STRAPPADO, n. *strūp-pā-dō*.

ESTRAY, v. *ēs-trā'* [OF. *estrayer*, to stray]: in *OE.*, to stray. ESTRAYS', n. plu. *-trāz'*, in *law*, valuable animals, whose owner is not known, found wandering. The law of E. varies in different states; usually cattle at large or doing damage in fields, etc., can be sent to a public pound, and if unclaimed after a fixed time, can be sold for damages and expenses, the balance going to the town-treasury. In some states they are advertized instead of impounded.

ESTREAT, n. *ēs-trēt'* [Norm. F. *estraite*—from L. *extractum*, copy of any original writing; *tractus*, drawn]: true extract copy of any original writing, especially of fines set down in the rolls of a court to be levied of any man for

ESTREEN—ESTREMOZ.

his offenses: see RECOGNIZANCE: V. to copy; to levy fines, etc., under an *estreat*. ESTREAT'ING, imp. ESTREAT'ED, pp. applied to the recognizances when the officer is directed to take out such a copy for the purpose of levying the amount.

ESTREEN, n. *ĕs-trēn'*: Scotch for YESTREEN, which see.

ESTRÉMADURA, *ĕs-trā-mā-dō'ră*: next to Alemtejo, the largest province of Portugal; 6,907 sq. m. The greater part of the country is hilly, but the hills do not attain great elevation. West of the estuary of the Tagus are the granite mountains of the Serra da Cintra, 1,500 to 1,800 ft. in height, terminating in the Cabo de Roca. South of the Tagus are barren moors, partly broken by morasses, and the limestone chain of Arrabida, rising to a height of 1,000 ft., and terminating in the Cabo de Espichel. Many districts are extremely fertile, others barren and uncultivated. The Tagus, which is navigable only as far as Abrantes, receives the waters of the Zezeres, the Sorraya, and the Canha, and is strewn with islands at its mouth. The chief productions of the country are wine, oil, fruits, corn, and cork; but even the sandy plains are covered with cistus, rosemary, myrtles, and other flowering and fragrant plants. The breeding of cattle is not much attended to. The minerals are marble, coal, and sea-salt. This province has been frequently visited by earthquakes.—Pop. including the cap., Lisbon (1877) 951,545; (1900) 1,232,593.

ESTRÉMADURA: previous to the new distribution of the country, a province of Spain; between Portugal and New Castile, watered by the Tagus and the Guadiana. It is bounded on the n. by Leon, on the s. by Andalusia, and, since 1833, has been divided into the two provinces of Badajos and Caceres; area 16,554 sq. m. Although a continuation of the high table-land of New Castile, E. is not, like it, a uniform plain, but is mountainous on the n. and s., and is well watered, the slopes of the hills being covered with wood, and the valleys with rich grass. Notwithstanding the fertility of the soil, the land has lain desolate and uncultivated ever since the expulsion of the Moors in the 13th c. This is chiefly to be attributed to the Mesta, or right of pasture, which causes the land to be regarded as the common property of the possessors of flocks. The breeding of goats, swine, horses, asses, and mules is much attended to. Silk and honey form considerable branches of trade. Grain is still imported. The mines, formerly very productive, are no longer wrought. Commerce is confined almost entirely to a contraband trade with Portugal. The inhabitants are poor, and, from the want of roads, isolated from the rest of Spain, and consequently in a low state of civilization. They make excellent soldiers, however, and have produced a series of brave *conquistadores* and generals. Pop. (1886) 799,659; (1900) 882,410.

ESTREMOZ, *ĕs-trā-mōz* : fortified town of Portugal, province of Alemtejo, 23 m. n.e. of Evora, and about the same distance e. of Elvas. It is built round the base of the hill

ESTRIDGE—ETAH.

on which its once formidable castle, erected 1320, is placed. It now ranks as the fourth or fifth stronghold in Portugal. E. is famous for manufactures of earthenware; its jars, of a porous clay, with the property of keeping water singularly cool, are of elegant shape, and are used all over the peninsula. The earthenware manufactures of E. seem to have continued unchanged since Roman times, as until the present day the forms into which the jars are cast are purely classical. In the neighborhood of E. is a marble quarry. Pop. about 8,000.

ESTRIDGE, n. *ěs'trīj*, or **ESTRICH**, n. *ěs'trīch*: in *OE.*, an ostrich.

ESTUARY, n. *ěs'tū-ă-rī* [L. *aestuāriūm*, an arm of the sea—from *aestuārē*, to rage or boil, as the sea—from *aestus*, heat, surge: F. *estuaire*; It. *estuario*]: the mouth of a tidal river; an arm of the sea; a frith. **ESTUARINE**, a. *ěs-tū-ă-rīn*, or *ěs'-*, of or pertaining to an estuary; formed in an estuary.

ESURIENT, a. *ěs-ū'rī-ěnt* [L. *esūriēn'tem*, desiring to eat, suffering hunger]: desirous to eat; hungry: N. one who is hungry; a greedy or avaricious man.

ESZEK, *ěs'sěk*: royal free town of Slavonia, on the right bank of the Drave, 12 m. above its confluence with the Danube, is the administrative cap. of the 'Kingdom,' and the most prosperous trading-town of Slavonia. Since the Drave began to be navigated downward to E. by steamers, the town has had prosperous trade in corn, wood, pigs, iron, deals, wine, and flax. The fortress of E., known in Roman times under the name of Mursia, is protected by a fort on the left bank of the Drave. In the fortress, the commander's dwelling and the town-house, and in the lower town the county buildings, are specially noticeable. During the Hungarian revolution, the town was at first held by Count Casimir Batthyányi, but capitulated, after a siege of several weeks, to the Austrian general. More than half the inhabitants are Rom. Catholics, the rest being Greek Catholics. Protestants, and Jews.—*Eszeg* is the Hungarian spelling of the Slavonian name *Essek*. Pop. about 20,000.

ESZTERHAZY: see ESTERHAZY.

ETACISM, n. *ā'ta-sizm* [F. *étacisme*]: in *philol.*, the method of pronouncing Greek in which the letter *η*, *eta*, has the sounds of *a* in *fate*. In modern Greek this letter has the sound of *ee* in *fleet*. **E'TACIST**, n. *-sist* [F. *étaciste*]: one who practices or defends etacism.

ETÆREIO, n. *ě-tē'rī-ō* [Gr. *etairiā*, fellowship, society]: in *bot.*, a fruit composed of several distinct one-seeded fruits or drupes, arranged upon an elevated receptacle or torus, as in the mulberry.

ÉTAGÈRE, n. *ā-tā-zhär* [F.—from *étager*, to raise by stages or stories; *étage*, a stage, a story]: a set of shelves in the form of an ornamental standing-piece of furniture, used for the display of articles of vertu.

ETAH, *ětā*: district of British India, in the division of Agra; between lat. $27^{\circ} 20' 30''$ and $28^{\circ} 1' \text{ n.}$, and long,

ÉTAMPES—ET.CETERA.

78° 29' and 79° 20' e.; 1,512 sq. m. It is an elevated alluvial plateau, with more than half its area under cultivation, and yields two harvests a year of wheat, barley, pulse, millet, cotton, sugar-cane, indigo, and opium. The Ganges river is the principal means of transportation. E. has 8 towns with pop. exceeding 5,000, and 5 municipalities. It was the seat of a primitive Arvan civilization, rich in temples and monasteries. Pop. nearly 800,000.

ÉTAMPES, *ā-tōngp'* (anc. *Stampæ*): town of France. dept. of Seine-et-Oise, 32 m. s.s.w. of Paris, on the Orleans railway. It consists mainly of one street, about four m. long. The chief buildings are the ecclesiastical edifices. E. has a public granary, capable of containing 1,400 tons of wheat. In and around E. are more than 40 flour-mills, constantly employed in providing for the Paris market; considerable quantities of garden-stuff are sent from this neighborhood to the capital. Pop. 8,000.

ÉTANG DE BERRE, *ā-tōng'dēh bär*: salt-lake of France, in the s. of the dept. of Bouches-du-Rhone, 11 m. long and 9 wide (at widest part), communicating with the sea by a narrow channel, called Tour-le-Bouc. This lake contains great quantities of eels and other fish. Salt-works are on its banks.

ETANIN, n. *ēt'a-nīn* [corrupted Arab]: in *astron.*, a fixed star of the second magnitude, called also ν Draconis. By it Bradley discovered the aberration of the fixed stars.

ÉTAT-MAJOR, n. *ā-tā-mā-zhawr'* [F.]: in *mil.*, the staff of an army or regiment. It includes all officers above the rank of colonel; all adjutants, quarter-masters, inspectors, engineers, commissaries, ordnance officers, pay-masters, surgeons, judge-advocates, and their non-commisioned assistants. In the department of military map-making, the English Ordnance Office corresponds in some respects with the French état-major.

ETAWAH, *ēt-ā'wā*, or **ITAWA** *īt-ā'wā*: district of which the town of Etawah is cap.; the lieut.-governorship of the N.W. Provinces. It lies entirely in the basin of the Jumna, and almost exclusively within the Doab, stretching in n. lat. 26° 21' to 27° 9', and in e. long. 78° 46' to 79° 49'; 1,694 sq. m. The district was at one time famous for the murderous fanaticism of the Thugs, 67 corpses of their strangled victims having been found in the wells during a single year. Pop. about 750,000.

ETAWAH: town of the Doab, near the left bank of the Jumna, about 70 m. below Agra, lat. 26° 46' n., and long. 79° 4' e. Though it is, on the whole, a dreary and mean place, yet it presents some remains of ancient grandeur, particularly many of those ghats or flights of stairs which facilitate the approach to the river for ritual ablution. Its prosperity, such as it is, is due chiefly to its position at the junction of the two roads which lead to Agra from Cawnpore and Calpee. Pop. about 35,000.

ET-CETERA, or **-CÆTERA**, *ēt-sēt'ē-rā* [L. *et*, and; *cætera*, other things]: commonly contracted into &c. or etc.—put

ETCH—ETCHMIADZIN.

at the end of a sentence, title, or announcement, to point out the fact that *other things* could be mentioned, or are to be understood as following; and so on. ET CÆTERA OATH, n. an oath imposed on the clergy by the Anglican bishops 1640, ‘binding them to attempt no alteration in the government of the Church by bishops, deans, archdeacons, etc.’

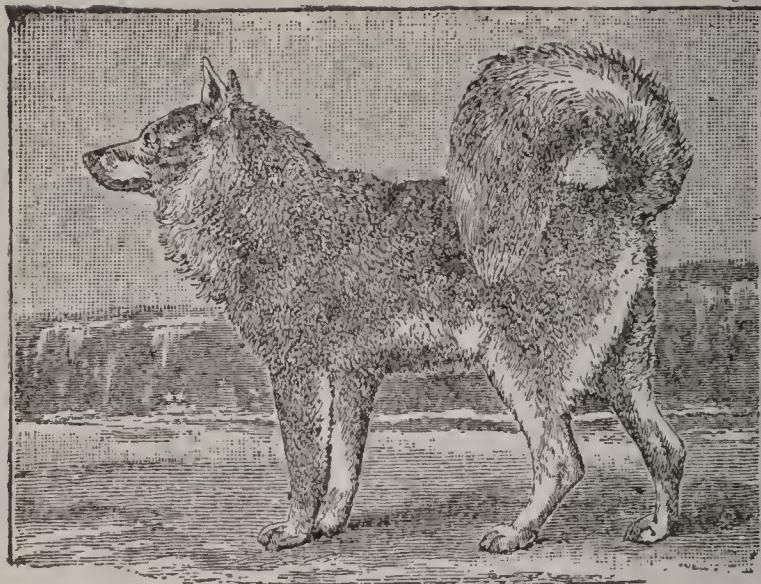
ETCH, v. *éch* [Dut. *etsen*, to etch—from Ger. *ätzen*, to cause to eat]: to engrave a metal plate by the eating or corroding power of an acid. ETCH'ING, imp.: N. the art of producing a picture on a metal plate by the eating power of an acid; the impression from the plate. ETCHED, pp. *écht*. ETCH'ER, n. one who. ETCHING-GROUND, the substance, usually a mixture of wax and resin, used to protect the surface of the metal, etc., from the action of the acid. ETCH'INGS, n. plu. impressions upon paper of designs etched on a plate of copper, steel, etc.: see HATCH, and note: also ENGRAVING.—ETCHING ON GLASS: see GLASS.

ETCHEMINS, *ét'ché-míñz*: ancient tribe of American Indians, supposed to have belonged to the Abenaqui nation and to have lived along the St. Croix river. They are now represented by the Penobscot and Passamaquoddy families, who occupy extensive reservations in the e. part of Me., adhere to the Rom. Cath. Church, and have schools and churches of their own. The families are about equally divided and aggregate 1,000.

ETCHMIADZIN, *etch-mē-ād-zēn'*, or ECHMIEDZIN, or EDCHMIADZIN, or ITSMIADZIN: town and monastery of Russia, govt. of Erivan; in the plain of the Araxes river, 12 m. w. of Erivan, 30 m. n. of Mount Ararat; elevation above sea level 2,985 ft.; seat of the Catholicos or primate of the Armenian Church. The monastery has the appearance of a strong fortification, and consists of a number of buildings, surrounded by brick walls 30 ft. high, provided with loop holes and towers. The cluster forms a quadrangle, on the w. side of which is the residence of the Catholicos, on the s. the refectory, on the e. the monks' lodgings, and on the n. the cells. There is a small cruciform cathedral, with two towers, a remarkable porch of red porphyry, and very rich interior decorations, where the Catholicos confers episc. consecration, and, once every 7 years, prepares the holy oil for use in all Armenian churches. The cathedral is said to number among its sacred relics the head of the spear which pierced the Savior's side, a piece of Noah's ark, and a piece of the true cross. Outside the main entrance are alabaster tombs of the Catholici Alexander I., Alexander II., Daniel, and Narses, and a marble monument over the grave of Sir John Macdonald, who died 1830 while on a mission to the Persian court. About half a mile from the cathedral are two churches, memorials to St. Rhipsime and St. Gaiana, early martyrs of Armenian Christianity, the latter being used for the burial place of all primates not pronounced by the synod worthy of interment beside the cathedral. Connected with the monastery is a library, said to have contained at one time 15,000 vols., but now reduced to about

PLATE 6.

Esquimaux Dog
Euterpe



Esquimaux Dog.



Estoile.



Eucalyptus Amygdalina.



Euterpe, from the Vatican.

ETERNAL—ÉTHELBERT.

2,500. These, however, furnish a rich storehouse of Armenian literature, and include ms. copies of the Gospels in carved ivory binding of the 10th or 11th c., and Bibles of the 13th c. A complete printing establishment, with type-foundry, presses, and book-binding requisites, is maintained by the monks, who publish a weekly newspaper, *The Ararat*, and various religious and educational works. A modern college and seminary stands e. of the monastery. The monastery is supported by an average annual revenue of \$50,000, derived from the conventual domains, which include a number of estates and 5 Russian villages. In 1872 the inmates numbered 5 bps. and abps., 20 monks, and 25 novices, and the pop. of the town was abt. 8,000. The monastery was founded by Narses II. who ruled 524-53, and since 1441 E. has been the centre of the Armenian Church.

ETERNAL, a. *ē-tér'näl* [F. *éternel*, eternal, perpetual—from L. *aeternális*—from *aeternus*, perpetual—from *ævum*, an age; akin to Skr. *ājus*, life: It. *eternale*]: without beginning or end of existence; without an end; everlasting; existing always without change: N. a title of Deity. **ETER'NALIST**, n. *-näl-ist*, one who holds the existence of the world to be eternal. **ETER'NALLY**, ad. *-lī*. **ETER'NITY**, n. *-ni-tī*, duration without beginning or end; endless future existence. **ETER'NIZE**, v. *-nīz*, to make endless; to immortalize. **E'TERNI'ZING**, imp. **ETER'NIZED**, pp. *-nīzd*. **ETERNAL CITY**, Rome, capital of Italy. **ETERNAL PUNISHMENT**: see HELL: IMMORTALITY. *Note*.—In popular usage, *eternal* and *everlasting* are very much used as synonymous. In the original Biblical use of the terms, however, *eternal* has for its primary significance, ‘beyond all conditions of time.’—**SYN.** of ‘eternal’: endless; infinite; ceaseless; interminable; perpetual.

ETERNE, a. *ē-térn'*: in *OE.*, perpetual; endless.

ETESIAN, a. *ē-tē'zhī-ān* [Gr. *etēsios*; L. *etesiūs*, annual—from Gr. *ētōs*, a year: F. *étésien*]: periodical; denoting a northerly or north-easterly wind that prevails all over Europe in early spring; in *Gr.* and *Rom.* authors, applied to the periodical winds in the Mediterranean, from whatever quarter they blow.

ETHANE, n. *ē'thān* [Eng. *ether*; termination used to denote that the hydrocarbon belongs to the series, C_nH_{2n+2}]: a hydrocarbon belonging to the paraffine series, obtained by the action of water, added drop by drop to zinc ethyl; also by the electrolysis of acetic acid or acetates; by heating an excess of barium dioxide with sand and acetic anhydride.

ETHELBERT, *ēth'ēl-bért*, King of Kent: abt. 552-616 (reigned abt. 560-616); fourth in direct descent from the great Hengist. He succeeded to the throne in about the eighth year of his age. The representative of the first Saxon king who ruled in England, and envious on that account of the title of Bretwalda, then held by Cealwin of Wessex, E. rashly undertook an expedition against that king in 568, a venture which, had he known the extent of country

ETHELREDA—ETHER.

covered by the West Saxons, he would probably never have made. The rival kings met at Wibbandune, now Wimbledon, in Surrey, where a great battle took place, resulting in the defeat of Ethelbert. This is recorded as the first battle that ever occurred between Anglo-Saxon sovereigns. Taught by disaster and danger, E. became more prudent. His subsequent schemes were more successful, and, about 590, he was acknowledged as Bretwaldæ of the Saxon octarchy, a dignity which he maintained to the close of his reign and life. In 570, E. married Bertha, a Frankish princess. The lady was a Christian, and it is said had stipulated, as a condition of her marriage, that she should be allowed, after her arrival in Kent, to practice her own religion. Her amiable piety had completely disarmed E. of all violence against the Christian religion long before the most important event of his life took place, viz., the formal introduction of Christianity into his kingdom. This was effected by the ministrations of St. Augustine, who was sent to Britain by Pope Gregory, and who landed in Kent 596. In the following year the king himself was converted, and Christianity established among the hitherto pagan Saxons. After his conversion and baptism, he founded the bishopric of Rochester, and, in concert with his nephew Sebert, King of Essex—who also had been converted—erected the church of St. Paul's in London.—E. is distinguished as the author of the first written Saxon laws. These are the *Dooms*, as they are called by Bede, ‘which he established with the consent of his Witan in the days of St. Augustine.’ They are in the Saxon language, and are the earliest written laws extant in any modern tongue.

ETHELREDA, *ēth-ēl-rē'da*, SAINT: daughter of the king of the East Angles, in the 7th c.; canonized for her saintly virtues, and whose festival in the calendar is Oct. 17. Her name was popularly abbreviated or corrupted into St. Audrey. At a fair in the Isle of Ely, called after her St. Audrey's Fair, it was customary to sell a common kind of lace, which came to be known as St. Audrey's lace. *Tawdry*, as applied to any inferior, and showy material, is believed to be a corrupt use of the term St. Audrey.

ETHENE, n. *ē'θēn* [adapted from *ether*]: heavy carburetted hydrogen or olefiant gas; also called *ethylene*.

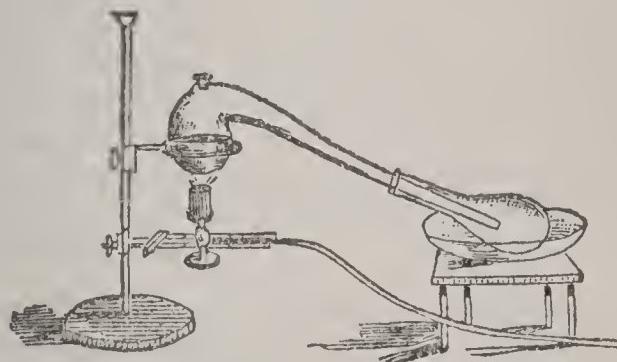
ETHENYL, n. *ēth'ēn-il* [Eng. *ethene*; Gr. *hulē*, matter]: triatomic fatty hydrocarbon radical derived from ethane, C_2H_6 , by the abstraction of three atoms of hydrogen.

ETHER, n. *ē'θēr* [F. *éther*—from L. *aether*; Gr. *aithēr*, the upper or pure air: It. *etere*]: an extremely fine fluid, supposed to fill all space beyond the limits of our atmosphere (see **ETHER**, or **ÆTHER**); a very light, volatile, and inflammable liquid, obtained from alcohol and an acid by distillation; the oxide of an acid radical. **ETHE'REAL**, a. *-thē'ri-äl*, heavenly; spiritual; celestial; resembling ether. **ETHE'REALLY**, ad. *-lī*. **ETHE'REALITY**, n. *-äl'i-tī*. **ETHERIZE**, v. *ē'θēr-īz*, to convert into ether; to stupefy with ether; to make spiritual. **ETHE'REALIZE**, v. *-äl-īz*. **ETHE'REALIZING**, imp. **ETHE'REALIZED**, pp. *-īzd*. **ETHERIFICATION**,

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n. *ē-thér'ī-fī-kā'shūn* [L. *faciō*, I make]: the act of making ether from alcohol. **ETHERIFORM**, n. *ē-thér'ī-fawrm* [L. *forma*, shape]: having the form of ether. **ETHERINE**, n. *ē-thér-in*, substance combined with etherol to form a light oily liquid that rises to the surface when heavy oil of wine is warmed with water. **ETHERISM**, n. -*izm* [Eng. *ether*; F. *éthérisme*]: in *med.*, effects produced on the human frame by the administration of ether. **ETHERIZA'TION**, n. -*ī-zā'-shūn* [F. *éthérisation*]: in *chem.*, process of manufacturing ether; in *med.*, art or act of administering ether to a patient; the state of the human frame under the influence of ether.

ETHER (otherwise called **EHYLIC ETHER**, or **VINIC ETHER**, or **SULPHURIC ETHER**): extremely volatile liquid, prepared from alcohol by the action of sulphuric acid at an elevated temperature. On the small scale, the apparatus which may be employed for the purpose is the retort and receiver, into which a mixture of equal weights of spirits



of wine, or rectified spirit and oil of vitriol, or, by volume, 2 of alcohol and 1 of sulphuric acid, are placed, and heat being cautiously applied, a liquid distils over, which consists of ether and water. In a short time, the contents of the retort begin to blacken, and the operation must be stopped, or the distillate will become contaminated with sulphurous acid. On the large scale, a modification of the process is carried on, which renders it theoretically a 'continuous process,' though, practically, there is a limit to the amount of ether distilled over.

The conversion of alcohol (C_2H_5OH) into ether (C_2H_5O) and water (H_2O) by oil of vitriol (H_2SO_4), was at one time considered to be due simply to the strong affinity of the oil of vitriol for water, which enabled it to take possession of the one atom of water, the elements of which form the only difference in the ultimate composition of alcohol and ether. This simple mode of explaining the process of etherification, however, does not acknowledge that the atom of water is not retained by the oil of vitriol, but is given off side by side with the ether in mechanical solution therewith. The theory of the process now generally accepted is too complex for introduction here.

Ether is a colorless, transparent, volatile liquid of great mobility and high refractive power with a fragrant odor, and a fiery, passing to a cooling, taste. When pure, it has the specific gravity 720 (water = 1000) at 60° F., though the commercial specimens are never free from water and alcohol, and have the density 740. It boils at 94.8° F.

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(the commercial at 96°), and yields a very dense vapor, the specific gravity of which is 2.586, as compared with air 1,000. When reduced to a temperature of — 24 F., ether freezes. It volatilizes spontaneously when unconfined, as in the palm of the hand, and vaporizes so quickly as to produce intense cold. Indeed, when water is covered with ether, and the latter assisted in its evaporation by being blown upon, it escapes so readily as to reduce the temperature of the water to 32° F., when it freezes. It is very inflammable, burning with a yellow-white flame; and mixed with air or oxygen, it gives rise to a dangerous explosive mixture, and hence great care requires to be taken in its distillation to keep all lights and fires out of the room where the vapors are condensing. When ether is added to its own bulk of water, briskly agitated, and allowed to settle, the two liquids appear to separate again; but it is found that the ether has taken up one-eighth of its volume of the water, while the latter has dissolved the same quantity of ether. It is readily miscible with alcohol in all proportions. Ether is one of the best solvents for the oils and fats, and hence is employed in analysis for the solution and separation of the oils from other organic matters, as in the analysis of oil-cakes, etc. It is also a good solvent of iodine, sulphur, phosphorus, and of strychnine, and other alkaloids, as well as corrosive sublimate, and other salts.

Ether is useful in the preparation of freezing mixtures, and the mixture of ether and solid carbonic acid gives the lowest temperature as yet attained. When inhaled by man and the lower animals, ether first produces stimulating and intoxicating effects, but afterward it gives rise to drowsiness, accompanied by complete insensibility, which entitles ether to be regarded as an important anaesthetic agent; and, indeed, for some time it was the only agent used for producing anaesthesia (q.v.) in surgical operations, but has been entirely superseded by the employment of chloroform.

Ether enters into combination with many acids, forming compound ethers, possessing great fragrancy; the more important of these are the following:

Acetic Ether,	$C_4H_5O, C_4H_3O_3$.	
Butyric Ether,	C_4H_5O, C_8H_7O ,	Pine-apple Oil.
Caproic Ether,	$C_4H_5O, C_{12}H_{11}O_3$	
Rutic Ether,	$C_4H_5O, C_{20}H_{19}O_3$	{ Essence of Melons.
Pelargonic Ether,	$C_4H_5O, C_{18}H_{17}O_3$,	Essence of Quinces.
Oenanthic Ether,	$C_4H_5O, C_{14}H_{13}O_2$,	Wine Oil.

There are other ethers, in which ordinary ether is not one of the members, as

Amyl Acetic Ether,	$C_{10}H_{11}O, C_4H_3O_3$,	Jargonelle Pear Oil.
Amyl Valerianic Ether,	$C_{10}H_{11}O, C_{10}H_9O_3$,	Apple Oil.
Methyl Salicylic Ether.	$C_2H_3O, C_{14}H_5O_5$,	Oil of Winter Greens.

ETHER, sometimes ÆTHER: the medium assumed in astronomy and physics as filling all space. It was shown by Newton, that if light consisted of material particles projected from luminous bodies, these must move *faster* in solids and liquids than in air, in order that the laws of refraction might be satisfied in their motions. Huyghens, on the other hand, showed that to account for the same

ETHERIA—ETHERSPHERE.

laws on the supposition that light consisted in the undulatory motions of an elastic medium, it must move more *slowly* in solids and fluids than in gases. Fizeau and Foucault have lately, by different methods, measured these velocities relatively, and have found Huyghens's prediction correct. Light, then, in the theory now accepted, consists in the vibratory motion of a medium, which must, of course, fill all space. This is called Ether. As yet, we have no idea as to its ultimate nature; some of our greatest philosophers, even, have supposed that it may be of the class of ordinary gases, and that our atmosphere, for instance, is not finite in extent, but pervades, with greatly reduced density, all interplanetary and interstellar space. Many objections, however, may easily be raised against this supposition. Meanwhile, the mathematical theory of light, on the hypothesis of undulations, requires that the vibrating medium should possess properties more nearly allied to those of an elastic *solid* than those of a liquid or a gas. The ether being *required* theoretically for explanation of the existence and the propagation of light, it becomes a matter of importance to inquire how many more of the physical forces may be referred to the same cause or medium. Radiant heat certainly may, and, probably, gravitation, molecular actions, magnetic, electric, and electro-dynamic attractions and repulsions, also are to be thus explained. As to sensible and latent heat, electricity and magnetism themselves, the necessity is not so clear; but even these have been of late *almost* satisfactorily explained by the hypothesis of the all-pervading ether: see FORCE: also see the same in reference to the impossibility of the ether's consisting of air or other gases, which are made up of distinct and separated particles.

ETHERIA, or *Æ*ETHERIA, n. *ē-thēr'ī-a* [L. *ætherius*; Gr. *aitherios*, belonging to the ether or upper air]: in zool., genus of mollusks, family *Unionidæ*. Known species four, from the Nile and the Senegal rivers. According to M. Calliard, the natives of the upper parts of the Nile valley use the shells in astonishing numbers to ornament their tombs.

ETHEROGRAPHY, n. *ē-thēr-ōg'rā-fī* [Gr. *aither*, the upper or pure air; *graphō*, I write]: a description of the atmosphere, its nature, uses, and phenomena; aerology.

ETHEROL, n. *ē-thēr-ōl* [Eng. *ether*; L. *oleum*, oil]: in chem., a yellowish viscid liquor obtained from heavy oil of wine. Sp. gr. 0·921; boils at 280°.

ETHERSPHERE, n. *ē-thēr-sfēr*: in *physics*, term introduced by the Rev. S. Earnshaw to illustrate an hypothesis of his. He considers that all space not filled by matter is filled by ether. If from any cause a portion of space be rendered void of this subtle existence, the medium outside the space will press it into smaller compass, and, if there be in it an atom of matter, the ether around it will become more dense under the influence of the pressure. The ethersphere is then the excess of ether about the vacant space above its original amount or quantity.

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ETHICS, n. plu. *ěth'iks* [L. *ethicūs*; Gr. *ethikós*, moral—from Gr. *ěthos*, manners, usage: F. *éthique*, ethics]: the science which treats of morality; that which relates to human actions, their motives and tendencies. ETH'IC, a. -*ik*, or ETH'ICAL, a. -*i-käl*, treating of manners or morals; moral. ETH'ICALLY, ad. -*li*. ETHICIST, n. -*i-sist*, a writer on ethics; one learned in ethics.—*Ethics* has primarily the same meaning as the more familiar term Morals. The science, treating of the nature and grounds of Moral Obligation, and expounding our various duties, is called sometimes by the one term, and sometimes by the other. This is a subject wherein opinions widely different from each other have been, and are still held. Hence, first to be considered is what are the chief points in dispute; and next, the positions taken by the opposing schools.

There are two distinct questions connected with the Theory of Morals. The first is the properly ethical question, and is, what is *the criterion of a moral act?* otherwise expressed as the *moral standard*—the circumstance determining an action to be *right*, and not *wrong*, nor simply *indifferent* as regards right or wrong. What determines our judgment in giving to some conduct *moral approbation*, and to other conduct *moral disapprobation*? We consider murder, theft, breach of promises or contracts, resistance to authority, cruelty, ingratitude, slander, polygamy, to be wrong or immoral, and the science of ethics is called upon to assign the reasons, why these various actions are so accounted.

The other question is properly psychological; in other words, relates to the constitution of the human mind. It is, by what *faculty of our nature* do we recognize this difference in actions? Is it by one of our ordinary intellectual faculties, such as Reason? or by some of our emotional susceptibilities, as Love and Hatred? or by a mixed faculty like Prudence? or by something peculiar and distinct, relating to this one object and no other, as the eye is formed for recognizing only color, and the ear only sound? This question has been often improperly mixed with the other, though there are certain theories wherein the answer to the first depends on the answer to the second.

As regards the standard of morals, it should be premised that punishment for neglect is what shows an action to be obligatory. We may dislike a man's conduct; but if we do not consider it deserving of punishment, it is not immoral in our eyes. People's imprudences, whereby they hurt themselves alone, are disapproved of; but there is seldom any disposition to step in by way of penalty in order to prevent such conduct; the disapprobation, therefore, is not of the moral kind. It may be said, however, that there is a tacit recognition of a sufficient punishment provided and sure to accrue in the nature of things. The punishment inflicted by society is partly legal, or through the civil government; and partly by public opinion, which, by attaching a stigma to certain conduct, is able to inspire no less dread than the civil authority. The punishment, by society acting in this way, is sometimes called the popular

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sanction, to distinguish it from the legal sanction. *Dishonor* is another name for the same thing. Many kinds of conduct tolerated by law, are nevertheless punished by the loss of public esteem and the infliction of disgrace. Cowardice, eccentricity, heterodoxy beyond certain limits, expose the individual to public censure. Many kinds of inhumanity, as maltreating dependents, have no other check than expressed disapprobation.

There have been various theories to show what is the principle of selection in the singling out of some actions to be authoritatively forbidden by Law and Society—that is, forbidden by the sanction of punishment. Some have said that the will of the Deity, or divine revelation, has indicated what we are not to do, and that there is nothing left to us but to conform to what is thus prescribed; others, as Cudworth, maintain, on the contrary, that what the Deity commands must be such as our own conscience approves, otherwise we could not give Him the character of being independently good and just. It has been said that Right Reason shows us the difference between right and wrong; this was Cudworth's own view: it may be conceived as another form of stating that a more or less bright and sure, yet always actual revelation of God exists in man's own nature, constituting his true and highest Reason, and varying in different men as all intellectual and physical powers vary. Samuel Clarke conceived that there was an eternal and intrinsic *fitness* in the things considered as right, and an unfitness in the wrong, 'with a regard to which the will of God always chooses, and which ought likewise to determine the wills of all subordinate rational beings.' Both these writers aimed at replying to Hobbes, who had maintained that the Civil Magistrate is supreme in Morality as well as politics; meaning, however, in all probability, that the magistrate himself ought to frame his dictates in one, as in the other, with a view to the public good, which would be a Utilitarian view. The phrase, 'the Moral Sense,' which represents what has been perhaps the most prevalent moral theory, occurs first in Lord Shaftesbury's *Inquiry Concerning Virtue*, from whom it was adopted by Hutcheson, and has since passed into general currency. Sometimes it has been maintained that a regard to self-interest is the only ultimate rule of right, which has a very different meaning, according as we look at self-exclusive, or inclusive, of other men's well-being. The most enlarged benevolence, in one view, is but an aspect of self. Adam Smith, in his *Theory of Moral Sentiments*, laid down as the criterion of right, the 'sympathetic feelings of the impartial and well-informed spectator.' But though this theory acknowledges our bias in the capacity of agents, it presumes us to be infallible when acting as judges or critics, a position far from self-evident. The spectator has his own failings as well as the actor, unless specially qualified by nature and education to act the part of a moral judge. Jeremy Bentham is known as the most distinguished propounder of the principle of Utility as the basis of morals, a principle explained by him as in contrast, first to asceticism, and next to 'sym-

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pathy and antipathy,' by which he meant to describe all those systems, such as the Moral Sense theory, that are grounded in internal feeling, instead of a regard to outward consequences. In opposing Utility to Asceticism, he intended to imply that there was no merit attaching to self-denial as such, and that the infliction of pain, or the surrender of pleasure, could be justified only by being the means of procuring a greater amount of happiness than was lost. Paley also repudiated the doctrine of a Moral Sense, and held that virtue is 'the doing good to mankind, in obedience to the will of God, and for the sake of everlasting happiness. The utilitarian theory of Bentham, with various modifications, has been defended and expounded by James Mill, in his *Analysis of the Human Mind*, and in his anonymous *Fragment on Mackintosh*; by John Austin, in his *Province of Jurisprudence Determined*; and by Mr. John Stuart Mill in his *Dissertations and Discussions*, and in *Frazer's Magazine* (1861, Oct. to Dec.).

The great controversy may be said to be between the adherents of the Moral Sense in some form or other, and those that deny both the existence of a separate faculty in the mind for perceiving moral distinctions, and the validity of the determinations of the individual conscience; maintaining (for in this form the assertion usually is presented) that morality ought to be founded on a regard to the well-being of mankind, and that exclusively; and that rules of morality grounded on any other motives are indefensible. In short, the question has been prevalently stated as being—and has actually, whether or not necessarily, come to be—Is morality an intuition of the mind, or is it like the government of the state, a positive institution, on which different societies may differ, and which may be set up or be abrogated at the pleasure of society?

The theory of intuitive Morality was vigorously assailed by Locke in his *Essay on the Understanding* (book i. chap. 3); and the party which he represents are accustomed to say that his objections to what he called 'innate practical principles' have never been answered. These objections have been given in a condensed form by Paley (*Moral Philosophy*, book i.). Locke urged that, in fact, there are no principles universally received among men; that moral rules require a reason to be given for them, which ought not to be necessary, if they are innate; that virtue is generally approved of, not because innate, but because profitable; that innumerable enormities have been practiced in various countries without even causing remorse; that the moral rules of some nations are flatly contradicted by others; that no one has ever been able to tell what the innate rules are; that we do not find children possessed of any moral rules, etc. To the objection, founded on the great variety and opposition of moral rules in different places and times, it has been replied that though the substance of the moral codes differ—one part of the world being monogamous and chaste, while other nations allow promiscuous intercourse of the sexes—all agree in enjoining some moral rules; nowhere is there an absence of social

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and moral obligations. The rejoinder has been that this is to depart from the original question, which was to assign the standard of morals, the criterion for determining which of two opposite courses—monogamy or polygamy—is the correct or moral course. This rejoinder brings to view one old and ever recurrent cause of confusion in this debate; the Utilitarians, making good their claim that moral rules often do, and presumably always should, *proceed* according to considerations of utility, unconsciously shift or enlarge that claim till it comes to this which is quite different—that rules of morality neither are nor should be ‘grounded on any other motives’ than utility. To show that utility is one of the useful or even indispensable criteria in moral processes, is not the same as showing that utility is the only foundation of morality itself. The intuitive moralists say that human nature is endowed with a faculty which tends to set up a discrimination between right and wrong, and which goes on to approve the right and disapprove of the wrong, and that we need not look beyond our own conscience to settle the point. The Utilitarians say, that when the existence of contradictory consciences is pointed out, it is not to the purpose to say that these are still consciences, and indicate something as obligatory; this all admit: what we desire is, to determine which we are to follow. But this criticism, though true, is not pertinent to the question as to the foundation, but only as to the proper exercise, of moral judgment: the intuitive moralist may reply with a similar criticism, relative to the contradictory views as to what actions are for true utility, or really tend to welfare.

Dr Whewell, in his *Elements of Morality*, has proposed to solve the difficulty by setting up a supreme or Standard Conscience, by which the individual conscience may be squared and corrected; but he has not told us who are the men whose conscience is the standard; it being obvious that the human race, as a whole, do not recognize any such, though each separate community might consent to take as models some of its most estimable citizens, or the interpreters of its religious code. The suggestion will arise in some minds that the supreme or standard conscience can be found by man only through some kind of manifestation of the Infinite and Eternal One.

The following is one view of the nature and origin of our moral principles which would seem free from the grave objections above alluded to. If we set aside for the present the question as to the *proper* standard of morals, the criterion that we should consider the right criterion, if we had to enact a code of morals for the first time, and if we look at the moral principles that have prevailed in different nations and times, we shall find that they have been dictated from two distinct kinds of motives. The one is Utility, in the sense of the common safety of men living in society. The prohibitions against manslaying, theft, breach of bargain, rebellion, are necessary, wherever men have formed themselves into communities; and it is the agreement in such matters as these—though subject still

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to very great varieties—that makes up the amount of uniformity actually observed in the moral codes of nations. If the society did not agree to protect life and property, by punishing the murderer and the thief, nothing would be gained by coming under the sway of government, and human beings would not associate themselves in tribes or nations. The common end might give a common character to the means, without supposing a special instinct to suggest that stealing is wrong. But, in the second place, there have been, in the moral codes of all countries, prohibitions not connected with any public utility, but prompted by strong sentimental likings or aversions, which have acquired the force of law, and are made the foundation of compulsory enactments. Of this kind is the antipathy of the Jew and the Mohammedan to the pig, the Hindu repugnance to animal food generally, and the usages of a merely ceremonial kind prevailing among many nations, which are as stringently enforced by law and public opinion as the sacredness of life and property. For a woman, among the Mussulmans, to expose her face in public, is as great an offence as going naked would be with us; while, among savage tribes, in warm climates, where clothing is little required, it is no shame to expose the whole person. For these practices, no reason can be given; the public sentiment has determined some things to be right and others wrong, without reference to any public or private utility; and it is in these enactments, founded on liking or disliking, that nations have differed most widely, the difference often amounting to contrariety. The ancient Greeks held it as a sacred obligation to drink wine in honor of Dionysus (Bacchus); the Nazarenes among the Jews and the Mohammedans entertained an opposite view. A legislator for the North American Indians might prohibit alcoholic liquors on the ground of public utility, the natives not being able to control themselves under stimulants; but the prohibition of wine in those other instances is probably a species of asceticism, or an aversion to human pleasures as such, which belongs to the domain of sentiment, and not to the consideration of utility.

There is, probably, an increasing tendency to recognize the supremacy of the principle of Utility both in Morals and in Legislation. Justice, truth, purity, though still sometimes viewed sentimentally, or as being ends themselves, are in men's practice looked upon more and more as of the nature of *means*, the promotion of human happiness being the end. See END (in Ethics). On this vexed question the final philosophy is probably not yet with us. When reached it will probably be found to involve the absolute and eternal Right as the only *foundation* of moral obligation,—the Right being recognized by man through some Divine manifestation to him or in him; and it will probably be found to present on this eternal foundation, the happiness or well-being of creatures as the *guiding principle* in all applications of morality in action and life.

The utilitarians point to a great number of the existing moral rules as traceable to a distinct historical origin, prov-

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ing that in their specific form as rules, they are not given by a universal instinct of the human mind. The Mohammedan code of morals came from Mohammed; Confucius was the moral legislator of one large section of the Chinese. The making of the marriage tie irrevocable in Christendom was an exercise of papal authority in the 13th c., and has since been repealed in some Protestant countries, although retained in Rom. Catholic states: see DIVORCE: MARRIAGE. The sentiment which forbids the holding of human beings as slaves is chiefly the growth of the last two or three centuries. But we are to avoid confusing real morality with legal morality: the two are cognate, but belong in diverse spheres—the legal having only indirect reference to character, and being developed principally in the sphere of public utility.

Although the doctrine of intuitive morality is, in this view, denied, it is still generally admitted by utilitarians that there is such a power in the mind as Conscience, which warns us when we are doing wrong, and is to a certain extent a force to make us do right. But they claim that it cannot be shown that we are born with any such principle, combining both enlightenment and motive power. Conscience is a *growth*. There are—thus they aver—in our constitution certain primitive impulses that so far coincide with what is our duty, and therefore contribute to the formation of the Conscience; these are principally Self-preservation, or a regard to ourselves, and Sympathy, or a regard to others. There are many duties that we are prompted to for our own interest, such as telling the truth, in order that people may confide in us; obeying the laws, to avoid punishment, etc. But we cannot perform all our social duties if we look merely to ourselves. We must, in addition to prudence, have a source of *disinterested* action, inducing us both to avoid injuring our fellow-beings in the promotion of our own selfishness, and occasionally to sacrifice ourselves for the sake of others. Such a principle exists in our mental nature, though not of equal strength in all minds. Being provided with these two primitive springs of action, we are susceptible of being educated to the sense of moral obligation. The child is first taught obedience by penalties, and is made to associate pain with forbidden actions. This is the germ of conscience. Habits of avoiding what is prohibited under penalties are gradually formed, and the sense of Authority and Law is thereby acquired. When the powers of observation and reason come to maturity, the individual sees why the restrictions of duty have been imposed, and is then ready of his own accord, and apart from the fear of punishment, to behave rightly. The Conscience, grounded on Fear, then becomes the Conscience grounded on spontaneous approval.

Conscience thus follows, and does not precede, the experience of human authority. Authority, sanctioned by punishment, is the type and the starting-point, even when the conscience takes an independent flight, and adopts

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rules for itself different from those that entered into its education. The great mass of human beings have nothing more than the slavish conscience, or the habits imparted by the exercise of the parental and public authority, which shows what is the most natural foundation of moral sentiment. The persons that judge of right for themselves, instead of implicitly receiving the maxims peculiar to the society where they grow up, are so few as to be the exception everywhere; their conscience does not prove what is the usual endowment of human nature in this respect.

Much in such views must instantly be conceded. But their precise bearing on the question at which they aim is denied by intuitive moralists, who point out that if Conscience be indeed a '*growth*,' it must grow from something, which something must be of a nature like unto it; and it is this moral germ in man's nature which is claimed as against the theory that grounds all morals and obligation on Utility. See UTILITY.

Inquiries of the nature of those above sketched, proceed upon the assumption that moral distinctions have their ground in the constitution of the world and of man's nature, and may be discovered by the exercise of human reason, as the other laws of the universe are. But practically, the rules of morality have, in almost all communities, been more or less dependent upon a belief in divine laws supernaturally revealed. For the relation of these to scientific ethics, see REVELATION.

ETHIDE, n. *ē īd |*: compound formed by the union of an element with the monad radical ethyl C_2H_5 —e.g., Zinc Ethide, $Zn''(C_2H_5)'_2$, generally called Zinc Ethyl.

ETHIDENE, n. *ē ī-dēn |* [from *ether*, and Gr. *eidos*, resemblance]: a substance nearly related in chemical composition to chloroform; a substance isomeric with ethene, and related to aldehyde.

ETHINE, n. *ē īn |*: in *chem.*, C_2H_2 or $HC = CH$, a hydrocarbon called also acetyline.

ETHIONATE, n. *ē ī-on-āt |*: a salt of ethionic acid.

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ETHIOPIA, ē-thi-ō-pi-a: the biblical *Kush*. Originally, all the nations inhabiting the southern part of the globe, as known to the ancients; or rather, all men of dark-brown or black color, were called Ethiopians (Gr. *aithō—ōps*, sunburned). Later, this name was given more particularly to the inhabitants of the countries s. of Libya and Egypt, or the Upper Nile, extending from 10°—25° n. lat. 45°—58° e. long.—the present Nubia, Sennaar, Kordofan, Abyssinia. The accounts which the ancients have left with respect to this people are, even when not entirely fabulous, extremely scanty and untrustworthy, as both Greeks and Romans never passed beyond Napata, 19° n. lat. From the Homeric age down to Ptolemy—who is somewhat better informed—these regions were reported as peopled by Pygmies, Troglodytes (dwellers in caverns), Blemmyes (hideous men), Macrobi (long-lived men), etc., besides being divided into the lands of cinnamon, myrrh, of elephant-eaters, fish-eaters, tortoise-eaters, serpent-eaters, etc. The only portion of ancient records which does contain something akin to historical accounts of these regions is that which refers to Meroë, an island formed by the rivers Astaphus and Astaboras, tributaries of the Nile. There stood, from times immemorial, an oracle of Jupiter Ammon. This, and the central position of the island, together with the extraordinary fertility of its soil, the abundance of animals, metals, etc., made it not only the chief place of resort for all the inhabitants of the adjacent parts, especially the numerous nomad tribes, but also the emporium for India, Arabia, Ethiopia, Egypt, Libya, and Carthage. Thus it grew so rapidly, that about B.C. 1,000 it counted among the most powerful states of the ancient world; and about B.C. 760, having ever since Sesostris been tributary to Egypt, it succeeded, under Sabacus, in shaking off the Egyptian yoke, and continued, in his turn, to hold Egypt for about 60 years. During the reign of Psammetichus, 240,000 Egyptians settled in Meroë, which, the greater part of the immigrants being artisans, traders, etc., advanced still more. Many new cities were built, and the state was in the most flourishing condition, when it was conquered by Cambyses, about B.C. 530. He fortified the capital town, and called it Meroë. After the destruction of Thebes by Cambyses, most of the inhabitants of that city took refuge there, and made the country still more Egyptian. Ergamenes transformed its theocracy into a military monarchy, in the 3d c. Under Augustus, Meroë was conquered, and a Queen Candace is mentioned as his vassal. Under Nero, nothing but ruins marked the place of this once powerful and highly civilized state. Till this day, remnants of mighty buildings, covered with sculptures—representations of priestly ceremonies, battles, etc.—and half-defaced inscriptions hewn in rocks, besides rows of broken sphinxes and colossi, are frequently met with in those parts.

Their religion, art, form of government, and civilization, generally were—in their chief features at least—so identical with the Egyptian as to have given rise to the ques-

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tion, which of the two nations imparted their knowledge to the other: see EGYPT.

The history of the descendants of the ancient Ethiopians—inhabitants of the present Habesch, or Abyssinia—may be outlined as follows from their very poor and scanty native chronicles.

According to these, the son of Solomon and the Queen of Sheba (Makeda as they, Balkis as the Arabians historians call her), named Menilehek, was the first king of the Ethiopians.* Few king's names occur before the time of Christ, when Bazen occupied the throne. The missionary Frumentius (330) found two brothers (Christians) reigning Abreha and Azbeha. During the time of the Greek emperor Justin (522), King Elezbass destroyed the state of the Homerites in Asia, in order to revenge their persecutions of Christians; and was canonized. From 960 to 1300, another dynasty, the Zagoeau, held the chief power, all the members of the Solomonic dynasty, save one, having been murdered by Esal, who made her son king. In 1300, Ikon-Amlak, descendant of this one scion of the house of David, who had fled to Sheba, regained possession of the country, and made Sheba, instead of Axum, the seat of government. To this day, his family rules the country. Frequent revolutions within, brought about especially by the religious squabbles imported by the Portuguese toward the end of the 15th c., and a host of enemies all around—the most formidable of whom were wild nomad tribes of the desert—forced the kings more than once to apply for foreign help; among others, that of the Turks 1503; and the affairs of the modern state have at all times been anything but prosperous. Special mention is made of King Zara-Jakob (Constantine), 1434–68, who sent an embassy to the church-council at Florence; of Aznaf-Saged (Claudius), 1540–59, during whose reign Christoph. de Gama from Portugal lived in Ethiopia, and made common cause with him against his enemies. This king also wrote a confession of faith, in which he defended his church both against Jesuits and the charge of leaning toward Judaism. Socinios (1605–32) openly professed Roman views; but his son Facilides soon expelled the Jesuits and their friends from the country, and put an end to the Roman influence. Among these friends was also Abba Gregorius, later the friend of the great Ethiopolologist Ludolf, who, having made his acquaintance at Rome, induced him to migrate to Gotba, where he remained until his death. Under Joas (1753–69), the Gallas, a nomad tribe, hitherto the mightiest and most dangerous enemies of the Ethiopians, not only gained admission to all the offices in the state, but acquired almost absolute power. One of them (Susul Michael), holding the place of Râsh, or prime minister and chief-commander of the troops, proved a very great friend to Bruce, to whom he intrusted the government of a province. The several provinces remained practically independent, each chief striving to subdue his neighbors, till in 1855 the chieftain afterward known as Theodore (q.v.) attained supremacy: see also ABYSSINIA. The king resided by

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rarely in the city, and for the most part remained with his soldiers in the camp. His official name was Negus, or, in full, Negus Nagass Za-itjopja, King of the Kings of Ethiopia—alluding to the chiefs of the towns and provinces. The soldiers receive no pay, but rely on plunder; and have proved themselves able to fight bravely.

Emigrants, as were beyond doubt the earliest settlers in Ethiopia, from the other side of the Arabian isthmus, it is but natural that the structure of their language, as well as that of their own bodies, should bear traces of their Shemitic origin. The reason of this emigration is contained in the very name of this language, which is called *Geez*—free, affording the most striking parallel to the designation *Franc*—French. Free places of habitation were what they came in search of. The name Ethiopian, or, as they call it, Ithiopjawan, they adopted from the Greeks at a very late period. This their oldest language, *Leshana Geez*, was suppressed by a royal decree of Ikon-Amlak, in the 14th c., and the Amharic adopted as the court language. Ever since, the Geez has, with exception of the province of Tigré, where it is still spoken (with slight idiomatic changes), remained the *Leshana Mazhab*, the language of books and of the church. It is exclusively used in writing, even of ordinary letters, and the educated alone understand it. Its general structure, comes as close to that of the Arabic as a dialect can and must. A great many of its words are still classical Arabic; others resemble more the Hebrew and its two Chaldee dialects, the Aramaic and Syriac; others, again, belong to African dialects; and many, as the names of the months, are Greek. It has 26 letters, 22 of which bear the ancient Shemitic stamp, and exhibit the greatest likeness to the Phœnician, the common original alphabet; and seven vowels, including a very short *e*, which sounds precisely like the Hebrew Schéwa. These vowels are represented by little hooks, and remain inseparably attached to their respective letters; and as the Geez, unlike all its sister-languages, is never written without vowels, the alphabet becomes a syllabary with 182 characters. Another difference exists in its being written from left to right—from which some have concluded that the Greeks introduced writing in Ethiopia; forgetting, in the first place, that Greek itself was frequently written from right to left, and that Zend, certain cuneiforms, hieroglyphs, etc., are likewise written from left to right. Not entering here into the grammatical minutiae of the language; we will mention that out of the ten conjugations, eight are Arabic; that there is a double infinitive, but no participle and no dual; that the formation of the so-called plural, and of declension generally, point to that very remote period when the Hebrew and Arabic made use of the same grammatical processes. There are no diacritical marks employed in writing; the letters are not combined, and the words are separated by two dots.

Although there can be no doubt of the existence of a rich literature in a flourishing country like Ethiopia anterior to Christ, still owing both to frequent internal convulsions

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and the misguided zeal of the early Christian missionaries, who here and elsewhere considered it their first duty to destroy all the ancient records of which they could lay hold, nothing but a few half-erased inscriptions have survived. The earliest existing document of post-Christian literature is a complete translation of the Bible, probably by Frumentius: see FRUMENTIUS. The Old Testament probably a translation from the Alexandrine version of the LXX., consists of four parts: 1, the Law or Octateuchos (five books of Moses, Joshua, Judges, Ruth); 2, Kings; 3, Solomon; 4, Prophets, and two books of the Maccabees. The New Testament consists of—1, Gospels; 2, Acts; 3, Paulus; 4, Apostolus. A very peculiar book, Henoch, also belongs to the literature of the Old Testament: see ENOCH. The New Testament comprises likewise another book, Senodas, containing the pseudo-Clementine or apostolical constitutions. The Ethiopians have a liturgy (*Kanan Kedaso*—Holy Kanon) and a symbolico-dogmatical work (*Haimanota Abau*—Belief of the Fathers), containing portions of homilies of the Greek Fathers, Athanasius, Basil the Great, Chrysostom, Cyril, Gregory of Nyssa and Nazianzen. Besides these, they have martyrologies, called Synaxar. They employ in this their sacred literature a peculiar kind of rhythm without a distinct metre. Any number of rhyming lines forms a stanza, without reference to the number of words constituting the verse, or of verses constituting the stanza. They also use certain phrases as a refrain—not unlike the manner of the mediæval Hebrew Pizmon: see JEWISH LITURGY. As to general literature, they have neither a written book of laws, nor a grammar of their own language, nor, in fact, anything worth mentioning, except a *Chronicle of Axum* and *Chronicles of Abyssinia*. They are very fond, however, of riddles, wise saws, and the like, so fascinating to the Eastern mind. They have a Dictionary, but most of its explanations and translations are utterly wrong. No wonder the learned in Europe should have been sorely puzzled by such a language, and that they should, after long consideration, have pronounced it to be either 'Chaldee' or 'Indian,' while Bruce held it to be the language of Adam and Eve. Potgen, a Cologne church-provost, happening to be at Rome at the beginning of the 16th c., there made the acquaintance of native Ethiopians, and became the first to enlighten the world on the nature of this occult language. After him came the Carmelite Jacob Marianus Victorius from Reate, who wrote *Institutiones Linguæ Chaldaæ S. Æthiop.* (Rome 1548), an entirely worthless book; then Wemmers, who 1683 published an Ethiopian grammar and dictionary. The principal investigator, however, is Hiob Ludulf from Gotha, who, aided by the Abba Gregorius before mentioned, and supported by his own extraordinary linguistic talents and indomitable energy, acquired such a power over this language, that notwithstanding the number of eminent Orientalists, such as Platt, Lawrence, Dorn, Hupfeld, Hoffmann, Roediger, Ewald, Isenberg, Blumen-

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bach, etc., who have since worked in this field, his books, as re-edited by Dillmann, still hold the first place. It is hardly necessary to add, that the Ethiopian is one of the most important and indispensable languages to the Semitic scholar, containing as it does a great many words and forms of a date anterior to the separation of the different Semitic dialects. Among the most important Ethiopian books printed in Europe are the Psalms, edited with a Latin translation by Ludolf (Frankfort 1701); the New Testament, (Rome 1548); the book of *Henoch* (Lond. 1840); *Ascensio Isaiae Vatis*, with a Latin translation by Lawrence (Oxford 1819); *Didascalia*, or apostolical constitution of the Abyssinian Church (Lond. 1834).—Ludolf's works are—*Grammatica Æthiopica* (Lond. 1661; new. ed. by Dillmann 1857); *Lexicon Æthiopicum* (Frankfort 1699; new. ed. 1862); *Historia Æthiopica* (1681). Since the English expedition to Abyssinia, the British museum possesses a larger number of Ethiopic mss. than any other library.

ETHIOPIAN, n. ē'thī-ō'pi-ān, or **ETHIOP**, n. ē'thī-ōp [Gr. *aithiōps*, sun-burnt, swarthy—from *aithein*, to light up, to burn; *ōps*, the face, the countenance]: a native of Ethiopia, and as such supposed to be black: ADJ. pertaining to. **ETHIOPIA**, n. ē'thī-ō'pi-ā, a country of Africa, which included the modern Abyssinia and several adjacent states. **E'THIOPIC**, a. -ōp'ik, pertaining to Ethiopia or its language; applied to the negro race as inhabiting Africa.

E'THIOPS [see *ÆTHIOPS*]: term applied by the ancient chemists to oxides and the sulphides of the metals which had a dull, dingy, or black appearance. Thus, *Ethiops Martialis* was the mixture of protoxide and peroxide of iron, known as the black oxide; *Ethiops Mineral Ethiops* or *Narcoticus*, the black gray sulphuret of mercury procured by triturating in a mortar a mixture of mercury and sulphur; and *Ethiops per se*, was obtained by agitating commercial mercury for weeks or months, when the oxygen of the air slowly formed the black oxide of mercury.

ETHMOID, a. ēth'moyd [Gr. *ethmos*, a sieve; *eidos*, appearance]: perforated with holes like a sieve—applied to the bone which forms the roof of the nose, which is perforated like a sieve for the passage of the olfactory nerves. It is one of the eight bones which collectively form the cavity of the cranium. It is of somewhat cubical form, and is between the two orbits of the eye, at the root of the nose. Its upper surface is perforated by a number of small openings, through which the filaments of the olfactory nerve pass downward from the interior of the skull to the seat of the sense of smell, in the upper part of the nose. It consists of a perpendicular central plate or lamella, which articulates with the vomer and with the central fibrocartilage, and thus assists in forming the septum or partition between the two nostrils. The lateral masses present a very complicated arrangement, and are so planned as to give in a small space a very large amount of surface, on which the filaments of the olfactory nerve are spread. In

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comparative anatomy we find a direct ratio between the development of these masses and the acuteness of the sense of smell. See NOSE AND THE SENSE OF SMELL. ETHMO-CRANIAL ANGLE, *eth'mo-krā'-ni-al*, in *anat.*, the angle formed by the basicranial axis with the line of the cri-brethmoid plate. The name was first given by Prof. Huxley. ETHMO-TURBINALS, n. *-tér'bí-nalz*, in *anat.*, two lateral masses, one on each side of the central vertical plate of the ethmoid bone.

ETHNICAL, a. *ěth'ní-kál*, or ETHNIC, a. *ěth'ník* [Gr. *ethníkós*, pagan, heathen—from *ěthnós*, a tribe, a nation]: relating to the different races or nations of mankind; heathen; gentile. ETH'NICALLY, ad. *-lī*. ETH'NICISM, n. *-sízm*, heathenism. ETHNOGRAPHY, n. *ěth-nōg'rá-fí* [Gr. *ethnos*, a race, a nation; *graphō*, I write]: an account or description of the origin, dispersion, connection, and characteristics of the various races of mankind. ETH'NOGRAPH'IC, a. *-nōgróf'ík*, pertaining to the origin, dispersion, etc., of mankind; also ETH'NOGRAPH'ICAL, a. *-i-kál*. ETHNOG'RAPHER, n. *-nōg'rá-fér*, one who cultivates or writes on the science of ethnography. ETHNOL'OGY, n. *-nōl'ō-jí* [Gr. *logos*, discourse]: the science of races, in all that relates to physical features, language, manners, religion, and other characteristics. ETH'NOLOG'ICAL, a. *-nō-lój'i-kál*, pertaining to ethnology. ETHNOL'OGIST, n. *-nōl'ō-jíst*, one who.

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ETHNOL'OGY: science that treats of the persistent modifications of the human family or group; their most marked physical, mental, and moral characteristics, when compared one with the other; their present geographical distribution on the globe; their history traced backward to the earliest attainable point; and finally, the languages of the various nations and tribes of mankind, existing or extinct, classified and compared, with the view, by their means, of determining the chief points of resemblance or dissimilarity among the nations of the earth. This science has gradually outgrown its name. It has been therefore deemed expedient to apply to it a term of wider and more neutral significance—namely, Anthropology—derived from the Greek, *anthropos*, man, and *logos*, a discourse. The term *Ethnology* has this inconvenience, that it means no more than the ‘science of races,’ and many authorities not only deny the existence of *races* of mankind, affirming that what are called races are in reality distinct species, but others argue that the term is as applicable to any races—e.g., races of dogs, or cats, or pigeons—as to the races of mankind. Hence the more exact and less sectarian term Anthropology has been applied to the science of the natural history of man. The science is divided into three branches—(1.) *Zoological Anthropology*, which treats of the relations of man to the brute creation; (2.) *Descriptive Anthropology*, or Ethnography, which classifies and describes the various and subdivisions of mankind, and marks out their geographical distribution; (3.) *General Anthropology*, which M. Broca calls ‘the biology of the human race,’ which, says a recent writer on the subject, ‘borrows and collates from all sciences facts and phenomena usually investigated in men as individuals, but which relate to men as groups of individuals,’ and compares these with other facts relating to other groups of individuals. The study and bare description of a single Negro’s skull is mere human anatomy; the study of a group of Negroes’ skulls, and the description and comparison of their peculiarities with those of groups of skulls belonging to other races, would be a specimen of the work done by General Anthropology.

No one can look at an Englishman, a Red Indian, and a Negro, without at once noticing the differences between the three, not only as regards the color of their skin, but the shape of the skull, the texture of the hair, and the character of the several features, as eyes, lips, nose, and cheek-bones. What strikes the ordinary observer chiefly is, of course, the difference of complexion; but the anatomist is fully as much interested in the shape of the skull. The first thoroughly scientific writer who endeavoured to lay down a method of distinguishing between the different races of mankind by a comparison of the shape and size of the skull was Peter Camper, a distinguished Dutch anatomist of last century. He laid down a technical rule for ascertaining the *facial line*, and determining the amount of the *facial angle*, which he has thus described: ‘The basis on which the distinction of nations is founded may be displayed by two straight lines, one of which is to be drawn

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through the *meatus auditorius* to the base of the nose, and the other touching the prominent centre of the forehead, and falling thence on the most advancing part of the upper jaw-bone, the head being viewed in profile. In the angle produced by these two lines may be said to consist not only the distinctions between the skulls of the several species of animals, but also those which are found to exist between different nations.' The heads of birds display the smallest angle, and it apparently becomes of greater extent 'in proportion as the animal approaches more nearly to the human figure. Thus, there is one species of the ape-tribe in which the head has a facial angle of 42 degrees; in another animal of the same family, which is one of those Simiæ most approximating in figure to mankind, the facial angle contains exactly 50 degrees. Next to this is the head of the African Negro, which, as well as that of the Kalmuk, forms an angle of 70 degrees; while the angle discovered in the heads of Europeans contains 80 degrees. On this difference of 10 degrees in the facial angle, the superior beauty of the European depends; while that high character of sublime beauty which is so striking in some works of ancient statuary, as in the head of Apollo, and in the Medusa of Sisocles, is given by an angle which amounts to 100 degrees. The nearer the facial angle approached a right angle, the greater was held to be the intellectual development of the race. But M. Jacquot, of the Natural History Museum in Paris, showed that the facial angle in stupid people very often approached closely a right angle, and that, in the homogeneous population of Paris, the facial angle varied within wider limits than those that Camper stated as a criterion of distinct species.

Camper's method was abandoned for the vertical method, or *norma verticalis*, invented by Blumenbach. The object being to collect the greatest number of characteristics—'The best way,' says Blumenbach, 'of obtaining this end is to place a series of skulls with the cheek-bones on the same horizontal line resting on the lower jaws; and then viewing them from behind, and fixing the eye on the vertex of each, to mark all the varieties in the shape of parts that contribute most to the national character, whether they consist in the direction of the maxillary and malar bones, in the breadth or narrowness of the oval figure presented by the vertex, or in the flattened or vaulted form of the frontal bone.' Founding upon this mode of admeasurement applied to a large collection of skulls of different nations, accumulated by himself, Blumenbach classified the human family into the following five varieties—viz., the Caucasian, Mongolian, Ethiopian, Malay, and American. In the first of these—which he made to include the Caucasians or Circassians Proper, the Celts, the Teutons, the Shemites, the Libyan family, the Nilotc family, and the Hindustanic family—the skull is large and oval, the forehead expanded, the nasal bones arched, the chin full, and the teeth vertical. In the second—which embraces the Chinese and Indo Chinese, the natives of the polar regions, the Mongol Tartars, and the Turks—the skull is oblong,

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but flattened at the sides, the forehead low and receding, the nose broad and short, and the cheek-bones broad and flat, with salient zygomatic arches. In the third--embracing the Negroes, Kafirs, Hottentots, Australians, Alforians and Oceanic Negroes--the skull is long and narrow, the forehead low, the nose broad and flat, the cheek-bones prominent, the jaws projecting like a muzzle, the lips thick, and the chin small. In the fourth--embracing the Malays and Polynesians generally--the skull is high and square, the forehead low, the nose short and broad, and the jaws projecting. In the fifth--embracing the American Indian family and the Toltican family--the skull is small, with the apex high, and the back part flat, the forehead receding, the cheek-bones high, the nose aquiline, the mouth large, and the lips tumid.

This classification of the human family, with the added characteristics under each class, of complexion, hair, and eyes is, upon the whole, the most popular, having been elaborated, and presented to the world by Blumenbach in a form acceptable to scientific inquirers. Later researches, however, have proved it not quite tenable. Thus, Cuvier reduced the five classes of Blumenbach to three--viz., the Caucasian, Mongolian, and Ethiopian, treating the Malay and American as subdivisions of the Mongolian. Jacquinot does the same. Dr. Prichard, who brought to the study of ethnology not only a large acquaintance with physiology, but considerable knowledge of languages, admits a greater number of varieties than Blumenbach; but divides his Caucasian class into two independent groups, which he calls the Syro-Arabian or Semitic, and the Aryan or Indo-Germanic. Moreover, he objects to the term Caucasian, as representing the notion that mankind had their origin on mountain heights. For himself, Prichard holds with the view that it was rather on the banks of large rivers and their estauries that the primitive nations developed themselves. 'The cradles or nurseries of the first nations, of those at least who became populous, and have left a name celebrated in later times, appear to have been extensive plains or valleys, traversed by navigable channels, and irrigated by perennial and fertilizing streams. Three such regions were the scenes of the earliest civilization of the human race, of the first foundation of cities, of the earliest political institutions, and of the invention of the arts which embellish human life. In one or these, the Semitic or Syro-Arabian nations exchanged the simple habits of wandering shepherds for the splendor and luxury of Nineveh and Babylon. In a second, the Indo-European or Japetic people brought to perfection the most elaborate of human dialects, destined to become in after-times, and under different modifications, the mother-tongue of the nations of Europe. In a third, the land of Ham, watered by the Nile, were invented hieroglyphical literature, and the arts in which Egypt far surpassed all the rest of the world in the earlier ages of history.' Dr. Prichard, in his well-known *Natural History of Man*, commences with a description of these three divisions of the human race, not as dis-

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criminated one from the other by the form of the skull, but as comprising nearly all the civilized communities, and indeed most of the tribes of people known to antiquity. 'They were neither nomades nor savages, nor do they display in their crania either of the forms principally belonging to races in those different states of existence. They had all heads of an oval or elliptico-spherical form, which are observed to prevail chiefly among nations who have their faculties developed by civilization.' As they cannot, however, by any means be made to comprehend all the types of man, after the Egyptians, he describes the great body of the nations of Africa, embracing tribes sunk in the lowest state of degradation; and after the Aryans, or Indo-Europeans, the people of high Asia, chiefly Nomades, inhabiting vast steppes, and never rising in the scale of civilization beyond the condition of wandering shepherds, though in this capacity possessing some wealth, and acquainted with the use of clothing, tents, and wagons. 'These classes of nations,' he observes, 'have different physical characters. Among the African savages we find the *prognathous* form of the head and all its accompaniments; and these traits display themselves in proportion to the moral and physical degradation of the race. In northern Asia, most of the inhabitants have the pyramidal and broad-faced skulls. See ARYAN RACE: EGYPT: SHEMITIC NATIONS.'

Of one of these three grand divisions of the human race, the Aryan, Dr. Prichard gives the following subdivision. The great Aryan or Indo-European race, which extends itself from the mouth of the Ganges to the British Islands and the northern extremities of Scandinavia, and now through a great extent of the American continent, divides itself, according to Prichard, into two branches—viz., the parent stock in Asia, and the colonies that it successively sent forth into Europe. The Asian branch comprises: 1. Hindus; 2. Persians; 3. Afghans; 4. Baluchi and Brahui; 5. Khurds; 6. Armenians; and 7. Ossetimes. The collective body of the European nations are now generally regarded as a series of colonies from Asia. The proof turns mainly on a comparison of languages; the ancient Sanscrit being regarded by the most competent judges as the parent, not only of the Greek and Latin languages, but of the Teutonic, with its several ramifications of the Slavonic, Lettish, Lithuanian, and even Celtic. Dr. Prichard himself was the first to point out the affinity of the Celtic with the Sanscrit, Greek, Latin, and Teutonic, in a memoir published 1831, on the *Eastern Origin of the Celtic Nations*. Later philologists have confirmed the view taken by him, and he is perhaps correct also in the conclusion, that they were the first great immigration of the Aryans into Europe, who were afterward conquered, and their numbers considerably reduced by fresh advancing colonies from the same parent hive. But there are other nations or tribes of Europe which no efforts of the philologists have succeeded in tracing to the Aryan stock; such are the Lapps, Finns, Tschudes, and Ugrians of the north, and the Euskaldunes, now principally represented by the Basques in the west.

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To these Dr. Prichard has given the appellation of Allophylian. [Gr. *allos*, another, and *phule*, tribe], thereby signifying their independence of the Aryan stock. The progenitors of these tribes were probably the inhabitants of Europe, prior to the first Aryan immigration.

After these several races, Dr. Prichard treats of the native tribes of the austral seas and the great Southern Ocean, and finally, of the native inhabitants of America. In every case, he carefully describes the physical appearance or structure, the geographical *habitat*, history, and migrations (if any), the language, and the moral and physical attributes of the nation or tribe, brought immediately under notice. His information has generally been obtained from the best sources, hence his works may be regarded as a storehouse of knowledge upon ethnology.

But both before and since Blumenbach and Prichard, there have been several classifications of the human race proposed, the simplest of which is perhaps that of Dr. Latham, into 1. Mongolidæ; 2. Atlantidæ; 3. Japetidæ. This writer was long properly regarded as the chief exponent of the science of E. in Britain. Following in the track of Prichard, and possessing, like him, a considerable acquaintance with physiology and history, he altogether surpasses him in the department of comparative philology. His contributions to the science of E., borrowed from this particular branch of study, are consequently of the highest value. But there is one important question, with respect to which the suffrages of the best philologists are rather with Prichard than with Latham—viz., the origin of the Aryan or Indo-European race. Prichard, as we have seen, refers it to Asia, while Latham claims it for Europe.

Retzius's classification is based on the idea that the psychical individuality of a race is expressed by brain-development as indicated by the shape of the skull. He divides races into—I. Dolichocephalic, or long-skulled races, where the length of the skull is due to a lengthening of the posterior lobes of the brain; and II. Brachycephalic, or short, broad-skulled races, in whom the comparative shortness of these lobes causes them to be more developed in breadth. These are subdivided, according to the form of the face, into (1) Orthognathous, or straight-faced peoples, e.g., Europeans; and (2) Prognathous, or races with projecting jaws, e.g., Negroes. This classification laid the foundation of ethnographic craniology. Zeune divides mankind into—(1) Races with high skulls, e.g., Indo-Europeans; (2) Races with broad skulls, e.g., Mongols and some Malay tribes; (3) Races with long skulls e.g., Negroes. Such classifications err in grouping under the same divisions races between which it is otherwise impossible to establish any consanguinity. Passing over the wild speculative classifications of the modern German materialistic school, a specimen of which is that of Carl Vogt (who, assuming the ape origin of mankind to be an indubitable fact, describes three great divisions of the human race in correspondence with the three species of anthropomorphic apes found in Asia, Africa, and America),

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The only other very recent classification with pretensions to scientific reasonableness, is that of Prof. Huxley, founded on the hair as a race-character. He describes two primary divisions—I. Ulotrichi, crisp or woolly-haired people, with skulls longer than they are broad (Dolichocephalic), and with the skin-color varying from yellow to black: Negroes, Bushmen, and Malays are sub-divisions of this great group. II. Leiotrichi, or smooth-haired people, subdivided into (1) the Australoid group, with 'dark eyes, wavy black hair, and eminently long, prognathous skulls, with well-developed brow ridges'; (2) The Mongoloid group, e.g., Chinese, Tatars, Polynesians, and American aborigines; (3) The Xanthochroic group, fair, blue-eyed people, e.g., Sclavs, Teutons, Scandinavians, and fair, Celtic-speaking nations; (4) The Melanochroic group, or pale-skinned people, with dark hair and eyes, e.g., the Iberians, or 'black Celts' of Europe, the inhabitants of the Mediterranean coast and of w. Asia—a group resulting probably from intermixture of the Australoid and Xanthochroic races. Under the Australoid group is classed such apparently unrelated races as the Australians, the Dekhan tribes in India, and the ancient Egyptians; and curiously enough, Colonel Lane Fox has since shown that, from resemblances in the weapons, implements, etc., in use among these very races, Prof. Huxley's apparently startling views as to their affinity are not improbable.

A more important question is, what do classifications classify—species or varieties? Prichard held that mankind sprang from one stock, and constituted one species. Existing diversities in form and physique in races he accounted for by the influence of food, climate, and other circumstances, operating through a long series of years. Mr. Darwin's recent work on *Animals and Plants under Domestication* powerfully corroborates this view, for it demonstrates that within the limits of one admitted species of animal there may be produced—as he claims, by the operation merely of artificial selection and hereditary transmission of peculiarities—diversities infinitely greater than those existing between the highest and lowest races of mankind. Then, again, the highest and lowest human races interbreed, and their offspring is fertile, which would hardly be the case if the parents were of different species. Some have held that the difficulties of migration from an original centre of creation were too great to be compatible with the wide geographical distribution of mankind. Yet even the South Sea Islanders—and in their case the difficulties alluded to must have been greater than in most others—may have come to their present abodes by migration; for Japanese mariners have sometimes by stress of weather been driven from their course, and cast on the shores of islands in the South Seas. This doctrine of monogeny, or original unity of the human race, is supported by Dr. Latham with arguments from philology. Dr. Latham, taking it as a matter of fact that all the languages of mankind have had a common origin, argues from it in favor of an original unity of race. This common origin of lan-

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guages, however, is a thing by no means proved. ‘The idea of an original language of the whole human race,’ says Dr. Waitz (*Introduct. Anthropologie Naturvölker*), ‘is by science now regarded as a chimera.’ Admitting that Klaproth, Fürst, and Delitzsch have taken great pains to establish an affinity between the Sanskrit and the Hebrew, M. Renan and other excellent authorities regard the attempt as unsuccessful, and, even were it otherwise, ‘the Chinese,’ says a late writer (Farrar, *Essay on the Origin of Language*), ‘must always remain a stumbling-block in the way of all theories respecting a primitive language. Radical as is the dissimilarity between Aryan and Semitic languages, and wide as is the abyss between their grammatical systems, yet they almost appear like sisters when compared with the Chinese, which has nothing like the organic principle of grammar at all. Indeed, so wide is the difference between Chinese and Sanscrit, that the richness of human intelligence in the formation of language receives no more striking illustration than the fact, that these languages have absolutely *nothing* in common except the end at which they aim. This end is in both cases the expression of thought, and it is attained as well in Chinese as in the grammatical languages, although the means are wholly different.’

The American school of E. hold views and conclusions totally different from those of Drs. Prichard and Latham. This school was founded by the late Dr. Morton of Philadelphia, an erudite and active man of science, who labored many years in forming a collection of human crania of all nations, and of ancient as well as modern ages, with the design of still further carrying out Blumenbach’s researches into the varieties of mankind by a comparison of crania, according to the method proposed by him. This collection of crania was begun 1830, and at the time of Morton’s death 1851, amounted to the large number of 918 human crania, to which were afterward added 51; and it included also 278 crania of mammals, 271 of birds, and 88 of reptiles—in all, 1606 skulls,—the largest collection of the kind ever formed, and which, fortunately for science, is now deposited in the Museum of the Acad. of Nat. Sciences at Philadelphia. Simultaneously with this accumulation of crania, Dr. Morton carried on his researches in E., not, however, in the restricted sense in which he began, following Blumenbach’s classification, but availing himself of the latest discoveries of Prichard, and the other English and continental writers. One of the results of his labors was the publication, 1839, of a handsome work, entitled *Crania Americana*, which was followed 1844 by the *Crania Aegyptiaca*, in the collection of which he had been much aided by Mr. G. R. Gliddon. ‘In this work,’ says his biographer, Dr. Patterson, ‘Morton found himself compelled to differ in opinion from the majority of scholars, in regard to certain points of primary importance.’ The great question of the unity or diversity of mankind in their origin was one that early forced itself upon his attention, and the conclusion at which he arrived, after

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much patient investigation, was in favor of the latter view. He was slow to publish any opinion on the subject, probably reserving it for a work upon which he was engaged, to be entitled *Elements of Ethnology*. His opinion, however, was well known to his friends. In a note to a paper in *Silliman's Journal* 1847, he says: 'I may here observe that whenever I have ventured an opinion on this question, it has been in favor of the doctrine of primeval diversities among men; an original adaptation of the several races to those varied circumstances of climate and locality which, while congenial to the one, are destructive to the other; and subsequent investigations have confirmed me in these views.' In a letter to Dr. Nott, dated 1850, Jan., he lays down the following proposition: 'That our species had its origin, not in one, but in several or in many creations, and that these diverging from their primitive centres, met and amalgamated in the progress of time, and have thus given rise to those intermediate links of organization which now connect the extremes together. Here is the truth divested of mystery; a system that explains the otherwise unintelligible phenomena so remarkably stamped on the races of men.' His latest utterance upon the subject is contained in a letter written to Mr. G. R. Gliddon, 1851, Apr., only a fortnight before the writer's decease, which concludes as follows: 'The doctrine of the original diversity of mankind unfolds itself to me more and more with the distinctness of revelation.' His views upon this and other points of dispute among ethnologists have been since embodied in a remarkable work, entitled *Types of Mankind; or, Ethnological Researches based upon the Ancient Monuments, Paintings, Sculptures, and Crania of Races, and upon their Natural, Geographical, Philological, and Biblical History: illustrated by Selections from the inedited Papers of S. G. Morton, M.D., and by additional Contributions from Professor L. Agassiz, W. Usher, M. D., and Professor H. S. Patterson*. By J. C. Nott, M.D., and G. R. Gliddon (Philadelphia 1854). In this composite work, perhaps the most remarkable feature is the paper contributed by the celebrated naturalist, Prof. Agassiz, in support of Dr. Morton's theory as to the original diversity of the human races.

The paper by Agassiz is entitled, *Sketch of the Natural Provinces of the Animal World, and their Relation to the Different Types of Man*. It was drawn up by the writer from a conviction that much might be gained in the study of ethnography by observing the natural relations between the different races of man and the plants and animals inhabiting the same regions. The sketch given by him is intended to show, that 'the boundaries within which the different natural combinations of animals are known to be circumscribed upon the surface of our earth coincide with the natural range of distinct types of man. Such natural combinations of animals circumscribed within definite boundaries are called *Faunæ*, whatever be their home—land, sea, or water.' There are eight regions of the earth, according to Agassiz, each containing its own faunæ, and its own peculiar type of man; and his main conclusion

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from a consideration of these several faunæ is as follows: 'That the diversity among animals is a fact determined by the will of the Creator, and their geographical distribution part of the general plan which unites all organized beings into one great organic conception; whence it follows that what are called human races, down to their specialization as nations, are distinct primordial forms of the type of man.' Messrs. Nott and Gliddon, in their work quoted, appeal triumphantly to this theory of Agassiz in support of their view as to the primitive diversity of the races of mankind; and in a subsequent work, *Indigenous Races of the Earth* (Philadelphia 1857), have inserted a further communication from the writer, in which, while he reiterates his formerly expressed opinion, that the races of man, so far as concerns their geographical distribution, are subject to the same circumscription as the other members of the animal kingdom, he observes: 'Even if this fact stood isolated, it would show how intimately the plan of the animal creation is linked with that of mankind. But this is not all. There are other features, occurring among animals, which require the most careful consideration, inasmuch as they bear precisely upon the question at issue, whether mankind originated from one stock or from several stocks, or by nations. These features, well known to every zoologist, have led to as conflicting views respecting the unity or plurality of certain types of animals as are prevailing respecting the unity or plurality of the origin of the human races. The controversy which has been carried on among zoologists upon this point, shows that the difficulties respecting the races of men are not peculiar to the question of man, but involve the investigation of the whole animal kingdom—though, strange as it may appear, they have always been considered without the least reference to one another.'

This theory of Agassiz, it must be stated, is very generally controverted, as likewise the opinions generally of Dr. Morton and the American school of ethnology, partly on Biblical, but chiefly on scientific grounds. Indeed, from the conflict of opinions as to the origin of the human race, if the solution of this question were the sole object of anthropology, the science might be said to be in a very unsatisfactory state. But this is not the case. The question at issue is one that may well be left in abeyance for the present. Without it, the field of inquiry is sufficiently wide, and is well cultivated by skilled laborers, who continually bring the product of their researches in physiology, geography, archæology, and comparative philology to enrich and fructify the newly turned-up soil.

Subjoined is the classification of Dr. Latham (to which Prof. Huxley's—above given—is now generally preferred):

I. MONGOLIDÆ.

Physical Characteristics.—Face broad and flat; frontal profile retiring or depressed; maxillary profile moderately prognathic or projecting, rarely orthognathic; eyes often oblique; skin rarely a true white, rarely a jet-black; irides

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generally dark; hair straight, and lank, and black, rarely light-colored, sometimes curly, rarely woolly. *Languages*—aptotic and agglutinate, rarely with a true amalgamate inflection: see LANGUAGE. *Distribution*—Asia, Polynesia, America. *Influence upon the history of the world*, material rather than moral.

A. ALTAIC MONGOLIDÆ.—1. *Seriform stock*, embracing Chinese, Tibetans, Anamese, Siamese, Kambojians, Burmese, the Môn, and numerous unplaced tribes. 2. *Turanian stock*, embracing the Mongolian branch, the Tungusian branch, the Turk branch, and the Ugrian branch.

B. DIOSCURIAN MONGOLIDÆ.—1. Georgians. 2. Lesgians. 3. Mizjeji. 4. Irôn. 5. Circassians.

C. OCEANIC MONGOLIDÆ.—1. *Amphinesian stock*, embracing Protonesians, Polynesians, Malegasi (?). 2. *Kelæ-nesian stock*, embracing the natives of New Guinea, New Ireland, Solomon's Isles, Louisade, New Caledonia, Australia, and Tasmania.

D. HYPERBOREAN MONGOLIDÆ.—1. Samœids. 2. Yeniseians. 3. Yukahiri.

E. PENINSULAR MONGOLIDÆ.—1. Koreans.—2. Japanese. 3. The Aino. 4. Koriaks. 5. Kamskadales.

F. AMERICAN MONGOLIDÆ.—Embracing the various native tribes of N. and S. America.

G. INDIAN MONGOLIDÆ.—1. Tamul. 2. Pulinda. 3. Brahu. 4. Indo-Gangetic. 5. Purbutti. 6. Cashmirian. 7. Cingalese. 8. Maldivian.

II. ATLANTIDÆ.

Physical Characteristics.—Maxillary profile projecting; nasal, generally flat; frontal, retiring; cranium, dolikohkephalic; the parietal diameter generally narrow; eyes rarely oblique; skin often jet-black, very rarely approaching a pure white; hair crisp, woolly, rarely straight, still more rarely light-colored. *Languages*, with an agglutinate, rarely an amalgamate inflection. *Distribution*, Africa. *Influence on the history of the world*, inconsiderable.

A. NEGRO ATLANTIDÆ.—Various negro tribes.

B. KAFIR ATLANTIDÆ.—Kafir tribes, etc.

C. HOTTENTOT ATLANTIDÆ.—1. Hottentots. 2. Saabs. 3. Dammaras.

D. NILOTIC ATLANTIDÆ.—1. Gallas. 2. Agows and Falasha. 3. Nubians. 4. Bishari. 5. M'Kuafi, etc.

E. AMAZIRGH ATLANTIDÆ.

F. EGYPTIAN ATLANTIDÆ.

G. SEMITIC ATLANTIDÆ.—1. Syrians. 2. Assyrians. 3. Babylonians. 4. Beni Terah (Edomites, Jews, Samaritans, etc.). 5. Arabs. 6. Ethiopians. 7. Canaanites, etc.

III. JAPETIDÆ.

Physical Characteristics.—Maxillary profile but little projecting; nasal often prominent; frontal sometimes nearly vertical; face rarely very flat, moderately broad; skull generally dolikohkephalic; eyes rarely oblique; skin white or brunette; hair never woolly, often light-colored; irides black, blue, gray. *Languages*, with amalgamate inflections, or else anaptotic; rarely agglutinate, never aptotic.

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Distribution, Europe. Influence on the history of the world, greater than that of either the Mongolidæ or the Atlantidæ, moral as well as material.

A. OCCIDENTAL JAPETIDÆ.—Kelts.

B. INDO-GERMANIC JAPETIDÆ.—I. European class, embracing Goths, Teutons (Mœso-Goths, High and Low Germans, Franks), Scandinavians, Sarmatians, Slavonians (Russians, Servians, Illyrians, Bohemians, Poles, Serbs), Mediterranean Indo-Germans (Hellenic branch, Italian branch. 2. Iranian class, embracing Persians, Kurds, Beluchi, Patans (Afghans), Tajiks, Siaposh, Lugmani, Dardoh, Wokhan. 3. Unplaced stocks, Armenians, Iberians-Albanians. 4. Extinct stocks, Pelasgi, Etruscans, populations of Asia Minor.

ETHOLOGY, n. *éth-öl'ö-jí* [Gr. *éthos*, use, disposition, or character formed by habit; *logos*, discourse]: the science which determines the kind of character produced in conformity to certain general laws, or by any set of circumstances, physical and moral; the theory of the causes which determine the type of character belonging to a people, or to an age. ETHOLOGICAL, a. *éth'ö-löj'ë-kál*, connected with or relating to ethology. ETHOL'OGIST, n. *-jist*, one versed in ETHOLOGY.

ETHULIA, n. *é-thü'lü-a* [etym. doubtful]: in bot., typical genus of the sub-tribe *Ethulieæ*.

ETHUSA, n. *é-thü'za* [Gr. *aithussō*, I put in rapid motion; I kindle]: genus of brachyurous short-tailed crustaceans: example, *Ethusa mascarone*.

ETHYL, n. *éth'il* [from *ether*, and Gr. *ülē*, the matter from which a thing is made], (symbol C₂H₅): the organic radical contained in ether and alcohol—the starting point of the family group, of which ordinary ether and alcohol are members.

Ethyl, C₂H₅.

Ether. C₂H₅O, Oxide of Ethyl.

Alcohol, C₂H₅O,HO, Hydrated Oxide of Ethyl.

It may be prepared by acting upon iodide of ethyl by granulated zinc, when the ethyl is liberated, and may be obtained as a colorless, inflammable gas, of an agreeable odor, insoluble in water, but soluble in alcohol. ETHYLIC, a. *éth'-ü'ik*, connected with ethyl. ETHYLAMINE, n. *-ä-min* [*ethyl* and *amine*]: substance strongly resembling ordinary ammonia or hartshorn in odor and other properties. It is found in coal-tar, in the oil obtained during the destructive distillation of bones, in the gases evolved during putrefaction, and may be produced by certain complicated chemical processes. Ethylamine is a mobile, transparent, colorless liquid of specific gravity 696 (water = 1,000), and boils at 66° F. It has a strong ammoniacal odor, has an alkaline action with coloring matters, forms white fumes with strong acids, and in composition is analogous to gaseous ammonia (NH₃ or NH₂H), with one of the atoms of hydrogen replaced by ethyl (C₂H₅O or Ac), and is represented by the symbol NH₂Ae or NH₂Ae. ETHYLENE, n. *éth'-ë-lë-në*: see ETHENE OLEFIANT GAS. ETHYL'IDENE, n.

ETIENNE—ETIOTIN.

i-dēnē, unsymmetrical hydrocarbon dyad radical. It is isomeric with the symmetrical dyad radical ethylene.

ETIENNE, St. *sāngt ā-tē-ēn'*: important manufacturing town of France, dept. of Loire; on both banks of the Furens, an affluent of the Loire, in the centre of a valuable and extensive coal-field, 30 m. s.s.w. of Lyon by rail, about 288 m. s.s.e. of Paris. It is surrounded by coal-mines, is seated upon coal-deposits, and has galleries driven even beneath its streets. The stream on which the town is built furnishes invaluable water-power to move its machinery, and its waters are also of great use for tempering iron and steel. The old town of St. E. is badly built, and the new town, which has sprung up very quickly, is destitute of architectural harmony. The newer houses are built of a fine white sandstone, and are frequently five and six stories in height; but they rapidly become tarnished and begrimed by the perpetual cloud of coal-smoke which hangs over the town. The most note-worthy building is the Hôtel-de-Ville, which contains the *Musée Industriel*, with specimens of the manufactures of the town, and of the minerals and fossils of the neighborhood. St. E. is famous for manufactures of ribbons and firearms. The ribbon manufactories contain 30,000 looms, and the annual value of their produce is estimated at 60,000,000 francs (\$11,518,750) in value. They are unrivalled in elegance of design, and in richness and delicacy of color, and are exported to all parts of the world. There are extensive private manufactories of firearms besides an imperial firearms manufactory, which supplies most of the muskets of the French army. St. E. has also extensive manufactures of bayonets, scythes, nails saw-blades, foils, anvils, vices, files; also of silks, velvets, lace, embroidery, muslins, glass, leather, and paper. From the coal-field on which St. E. is situated, about 600,000 tons of coal are raised annually. On 1866, Jan. 1, St. E. was constituted cap. of the dept. St. E. arose originally from a castle built in the 10th c. by the Counts of Forez. It increased greatly in the 15th c. Pop. (1771) 20,000; (1851) 49,614; (1872) 80,526; (1876) 117,537; (1901) 146,559.

ETIOLATE, v. *ē-tē-ō-lāt'* [F. *étioyer*, in *gardening*, to grow up long-shanked and colorless]: to whiten by excluding the light of the sun; to blanch; to become white. ETIOLATING, imp. ETIOLATED, pp.: ADJ. applied to the whitening of the leaves and the lengthening of the stem of a plant by its being suffered to grow in a shady or dark situation. ETIOLATION, n. *-lā'shūn*, the act of becoming white by the absence of light; absence of green color, the process of blanching plants by excluding the action of light.

ETIOLOGY, or AETIOLOGY, n. *ē-tē-ōl'ō-jī* [F. *étiologie*—from Gr. *aitia*, a cause; *logos*, a discourse]: the doctrine of causes, particularly with reference to diseases; the science of the origin and development of things. ETIOLOGICAL, a. *-lōj'ē-kāl*, connected with or related to etiology.

ETIOTIN, n. *ē-tē-o-tīn*: in chem., yellow coloring matter, found in plants which have grown in the dark.

ETIQUETTE—ETNA.

ETIQUETTE, n. *éti-két'* [F. *étiquette*, a ticket on which the forms to be observed on particular occasions were inscribed]: forms of civility, manners or good breeding; the ceremonial code of polite society. Originally, etiquette signified a little piece of paper affixed to a bag or other object to signify its contents. The word came probably to possess the secondary meaning which we now attach to it, of the forms or decorums observed in the intercourse of life, particularly on state occasions, from its having been customary to deliver such tickets, instructing each person who was to take part in the ceremony as to the part which he was expected to take. The cards which are still delivered to the mourners at funerals, and those on which the order of the dances is set forth at balls and evening parties, are of this nature.

ETIVE, *éti've*: sea-loch in the n. of Argyleshire, Scotland, extending inland from the Firth of Lorn, 20 m. e. and n.e., with a breadth of a quarter of a mile to three m. It is bordered by granite in its upper part, and by trap in its lower. Near its mouth, there is mica-slate on the n. side, and Permian strata on the south. The river Awe, the outlet of Loch Awe, falls into the loch at the bend, where also is the ferry of Bunawe, and the small river Etive falls into it at its n.e. end. The loch abounds in seals, salmon, porpoises, and cod. The scenery around the upper half of the loch is grand and romantic. To the e. rise Ben Cruachan, 3,670 ft. and Ben Starive, 2,500 ft. and to the n. is Ben Mahr-gage. The loch admits small coasting-vessels. Ardhattan Priory, founded in the 13th c., on the site of a monastery of the 6th or 7th c., is now in ruins. Connel Ferry, in the lower part of the loch, near a vitrified fort, is only 680 ft. broad, and is a very turbulent cataract, three or four ft. high at half-tide, caused by a sunken reef of rocks, partly bare at low water. At the s. side of the mouth of Loch E., three m. n. of Oban, on a projecting conglomerate rock 10 to 30 ft. high, are the ruins of Dunstaffnage Castle, the ancient stronghold of the Macdougals, a building in what is called the Edwardian style of the end of the 13th or beginning of the 14th c., with walls 400 ft. in circumference, 30 to 50 ft. high, and 10 ft. thick, and with three round towers. Dunstaffnage is supposed by some to have been the seat of the Dalriadic Scottish monarchy (see DALRIADA), and from this place the famous slab or Stone of Destiny (*Lia Fail*), now in the coronation-chair, Westminster Abbey, is said to have been taken 843 by Kenneth Maeal-pine to Scone, whence Edward I. removed it to London.

ETNA, n. *éti'na* [after the volcano *Etna*]: a familiar name for a water-boiler heated by spirit.

ETNA, or *ÆTNA*, *éti'ná* (now MONTE GIBELLO): largest volcano in Europe. It is an isolated mountain, on the coast of Sicily, and cut off from the chain of mountains parallel with the n. shore of the island, by a small valley, through which flows the Alcantara, and from the s. chain by a larger valley, which forms the basin of the Giaretta. Its e. side rises directly from the Mediterranean, 30 m. of

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coast being formed by the streams of its lavas. Its base is almost 90 m. in circumference, and from this it rises like an immense cone to the height of 10,874 feet.

The history of E. does not carry us far back geologically; an active volcano in the later portion of the Tertiary period, it continues still to pour forth materials; and the ejected ashes, dust, and lapilli, together with the streams of molten lava, have, in the course of untold ages, built up this immense mountain. One central crater has been the prevailing outlet for these materials, and they have consequently arranged themselves into one central and dominant mound—the cone-shaped E.; but innumerable secondary and surrounding craters, each forming, by its ejected matter, an external smaller cone, exist on Etna. Many of these, in the increase of the mountain, have been covered and hid by the more recent eruptions. Eighty of them may be counted surrounding the upper portion of E., many being hills of considerable altitude, but all appearing only as trifling irregularities



Distant View of Etna.

when viewed at a distance as subordinate points of so colossal a mountain. Seen from the summit, they present a beautiful aspect; some bare and barren, others covered with the dark and sombre pine, or with the gayer and more varied foliage of the oak, the beech, and the hawthorn, and all arranged in picturesque groups of various heights and sizes. But the most remarkable feature in E. is the Val del Bove, an immense gully excavating the eastern flank of the mountain, five m. across, and surrounded by nearly vertical precipices 1,000 to 5,000 ft. high, on which are shown sections of innumerable lava-streams and beds of scoriæ, traversed by highly inclined dikes. It has a singularly dreary and blasted appearance.

The summit of E. rises considerably above the line of vegetation, and consequently presents, except where covered with snow, a dreary waste of black lava, scoriæ, and ashes, in the centre of which, in a desolate plain, rises the crater-bearing cone. This is called the Desert region. It is followed by six or seven m. of the Woody region, in which

ETOLIA—ETON COLLEGE.

Luxuriant forests of pine, oak, beech, poplar, and hawthorn abound, with rich pastureage for herds and flocks. A varying breadth of from two to eleven m. of cultivated region surrounds the base of Etna. Its great products are corn, oil, wine, fruit, and aromatic herbs.

The first recorded eruption of E. took place B.C. 476. The most remarkable that have occurred since are the following: A.D. 1169, when Catania and 15,000 of its inhabitants were destroyed; 1527, in which two villages and many human beings perished; the eruption which continued at intervals 1664–73, and destroyed many villages with their inhabitants. Numerous chasms were formed at this time; from one several miles long and four or five ft. wide were emitted a bright light and strong sulphurous vapor; from another, black smoke and quantities of stones were given out; and from others, streams of lava. In 1673, an immense volume of salt (?) water rushed down the mountain: by some, it is supposed to have been ejected from the crater, but it is more probable that it arose from the sudden melting of the snows which covered the summit of the mountain. A very great eruption took place 1852. Immense clouds of ash-gray dust were ejected. From two new mouths on the eastern flank there issued vast torrents of lava, one of which was two m. broad, and at one time as much as 170 ft. deep. The next outbreak, 1864–5, was not important. That of 1879, May, was much more violent; the clouds of smoke and showers of ashes and scoriae being followed by the ejection of a torrent of lava 200 to 300 ft. in width which desolated a large tract of highly cultivated land.

The minerals peculiar to volcanic rocks occur at E., such as chrysolite, zeolite, selenite, alum, nitre, vitriol, copper, mercury, and spicular iron.

ETOLIA : see *ÆTOLIA*.

ETON, *ē'ton*: town in the s. of Buckinghamshire, England, on the left bank of the Thames, 42 m. s.s.e. of Buckingham, 22 m. w.s.w. of London, near the Slough station of the Great Western railway. It lies opposite to Windsor, in Berkshire, with which it is connected by bridge over the Thames. Though in separate counties, these two towns really form one. E. consists chiefly of one long well-paved street, and is mainly dependent on the college. Pop., exclusive of the Eton boys, (1881) 3,466; (1891) 2,499.

ETON COLLEGE : one of the most famous educational establishments in England; founded 1440 by Henry VI., under the title of ‘The College of the Blessed Mary of Eton beside Windsor.’ The original foundation consisted of a provost, 10 priests, 4 clerks, 6 choristers, 25 poor grammar scholars, a master, and 25 poor infirm men. The king provided for the establishment out of his own demesne lands and the estates of certain alien priories. A supplementary charter was granted 1441, in which year also the college buildings were commenced. Henry was very solicitous that the work should be of a durable kind. Some of the buildings were finished 1443, and were transferred by the royal commissioners to the provost, clerk, and scholars.

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Political troubles of various kinds retarded the completion of the buildings till 1523. Bp. Waynflete was the first head-master, and afterward a munificent supporter of the college. The institution passed through much peril in the reign of Edward IV., and again in the time of the Commonwealth; but it surmounted the dangers, and the increasing value of its estates brought in a large income.

The original foundation has been greatly modified under the Public Schools Act, 1868. It now consists of a provost and 10 fellows, who constitute the 'governing body,' 2 chaplains or conducts, and 70 scholars. The members of the governing body are nominated by the universities of Oxford and Cambridge, and other learned and responsible electors. Several valuable scholarships at King's College, Cambridge, are filled every year from among the scholars by competitive examination. There are other scholarships and prizes open to all the members of the school, such as the Newcastle and Tomline scholarships, and prizes for modern languages, founded by the late prince consort. The scholars are lodged within the college walls.

The main portion of the students, however, numbering nearly 900, are *oppidans*, students who live out of the college, and whose friends pay liberally for their education. The tuition is the same for them as for the *collegers* or scholars. There are an upper and a lower school, managed by the head master and lower master, with a large staff of assistants. Much discussion has arisen in the last few years concerning the kind of education received at Eton, the cost at which it is obtained, and the enormous incomes derived by some of the officials. The course of education is still somewhat medieval, which regards Greek and Latin as the basis of all good education; but mathematics and natural science, under recent regulations of the governing body, receive much attention. There is great prestige connected with the college.

The chief buildings of the college consist of the chapel, the hall, the library, the schools, the provost's and master's apartments, and the lodgings of the fellows, surrounding two quadrangles; together with the boys' library and sleeping apartments, in a cluster called the new buildings, attached to the n. side of the older group. The chapel is mostly of stone; the other buildings are of brick; and the effect of the whole is very picturesque, as seen from the terrace of Windsor Castle, on the other side of the Thames. The chapel is especially beautiful. The houses of the masters are generally fitted up for the reception of oppidans as boarders. **ETONIAN**, n. *ē-tōn'ī-an*, a boy educated at Eton.

ETRURIA.

ETRURIA, n. ē-trō'rī-ă, anciently called also TYRRHENIA, or TUSCIA: ancient kingdom of Italy, comprehending nearly all Tuscany, Lucca, and part of the former Roman States. ETRUSCAN, a. ē-trū'skān, pertaining to Etruria.—*Etruria*, at a period anterior to the foundation of Rome, designates nearly the whole of Italy, together with some of its most important western islands. Its n. part, from the Alps to the Apennines, was known under the name of Etruria Circumpadana; its s. from the Tiber down to the Gulf of Pæstum, or, according to some, to the Sicilian Sea, under the name of Etruria Campaniana; while the central portion, bounded n. by the Apennines and the river Macra, s. and e. by the Tiber, and w. by the Tyrrhenian Sea, was called Etruria Propria. The first two, however, did not long remain Etruscan territory, but were either reconquered by the surrounding tribes to whom they had originally belonged, or fell into the hands of new immigrants. No historical records of that brief period of any moment having yet come to light, they do not claim our attention; while Etruria Proper, scanty as is our information about it, attracts a high degree of interest. For its physical features, see TUSCANY: LUCCA: also the Transtiberine portions of the Papal Dominions. It is to be remarked here, however, that vast expanses of that country, now either covered with deep forest, or shunned on account of malaria, were in those times fruitful, densely peopled regions. For political, or rather administrative purposes, Etruria Proper was divided into 12 sovereign cities, or rather cantons, among which the most important were Tarquinii (Corneto), the cradle of the royal family of the Tarquins, who at one time wielded the sceptre of Rome; Cære (Argylla Cervetri), which, during the war of Rome with the Gauls, offered a refuge to the Roman Flamen Quirinalis and Vestal Virgins; Veii, the greatest and most powerful city of Etruria, with 100,000 inhabitants, which carried on seven wars with Rome; Clusium (Kamars, Chiusi), the chief of which, Por-sena, as principal commander of the Etruscan troops, dictated a humiliating peace to Rome after she had expelled the Tarquins; Perusia (Perugia), destroyed in the Perusian civil war (40); Arretium (Arezzo), birthplace of Mæcenas. Of other not sovereign places may be mentioned Luca (Lucca), Pisæ (Pisa), on the Arnus, with the Portus Pisanus, now Leghorn, and Florentia (Firenze, Florence), on the Arnus.

To what nation the inhabitants—called Etruscans (= Exteri, strangers) or Tuscans in the Roman, Tyrrheni or Tyrseni (*Turrēnoi*, *Tursēnoi*) in the Greek, and Rasena (Tesne Rasne) in their own language—originally belonged, and what country they came from, was debated many hundred years before Christ, and is not settled yet. All the most ancient writers, save one of the most trustworthy, Dionysius of Halicarnassus, implicitly follow Herodotus, who—confounding the Etruscans, perhaps, as is his wont, with the Lydian *Turrēnoi*, or inhabitants of the city of Tyrrha—pronounces them Lydians, though there is not the slightest similarity between these two nations, and

though Xanthus, the Lydian historian, knows nothing whatever about a fabled famine of 18 years' duration in Lydia, followed by an emigration to Italy under a Prince Tyrrhenus. Dionysius himself offers no opinion; he calls them an indigenous race—which gives no real information; and it is surprising that some modern investigators, despairing of a rational solution of the old riddle, should have fallen back upon this evasive theory of ‘autochthons.’ Thucydides, in first confusing the Torrhebian pirates with the Pelasgian filibusters, gave rise to hopeless confusion about their very name. As to the innumerable theories and hypotheses since his day: Ciampi and Collar deem these people of Slavonic origin; Fréret calls them Celts; Micali, Albanese; Lami, Pfitzmaier, and Stickel, Semitics; and others variously make them Goths, Scandinavians, Basques, Assyrians, Phœnicians, Egyptians, and Armenians. The most rational and generally accepted opinion is that of Niebuhr—modified more or less by Ottfried Müller, Lanzi, Lepsius, Steub—of their being, when they first appear in history, a mixture of an eastern tribe, which had settled for a while in the Rhætian Alps (the Tyrol of to-day), and Pelasgians, whom they had found in their new Italian seats; these latter having, in their turn, since their immigration, mixed with the Umbrians, the oldest historical inhabitants of those parts. But, this is only the most rational opinion that emerges from a mist of wild speculation: authentic proofs of it have not yet been found; the question stands to-day precisely where it stood when Dionysius wrote: ‘The Etruscans do not resemble any people in language and manners.’

Immense as was their influence on Roman, and, in fact, on European civilization, very little is known of their political history. Chiefly cultivating the arts of peace, they nevertheless seem, long after their heroic period, to have been powerful enough to scare away any invader, and this probably is the reason why historians have so little to record of them; but their decline may be said to stand in an inverted ratio to the rise of Rome. The 7th and earlier half of the 6th c. B.C. had been the most powerful and flourishing epoch of the Etruscan state in its widest sense—which then probably had been in existence four or five hundred years. Whether they had put their Tarquinii as governors over conquered Rome, or whether, on the contrary, the reign of this Etruscan family would denote the subjugation of southern Etruria by Rome, is not clear; but the expulsion of the last Roman king, Tarquinius (Tarchon), called Superbus, was followed, about B.C. 507, by a war between the Etruscans, under Porsena of Clusium, and the Romans, which, though ending in a most ignominious peace, dictated within the walls of Rome, did not bring about the restoration of the Tarquinian dynasty. From the wars between Veii and Rome, which began B.C. 486, and ended—interrupted only by an occasional armistice—395, with the destruction of Veii, dates the gradual but sure extinction of Etruria as an independent state. The Gauls advancing from the n., the Etruscans were forced to

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conclude a 40 years' truce with their adversaies at any price; but these over, and the Romans being engaged with the Samnites, the Etruscans recommenced the hostilities more fiercely than ever. In this last war, the Romans succeeded, B.C. 309, under Q. Fabius Maximus, in twice defeating them, and Fabius crossed the Ciminian forest—the frontier sacred from time immemorial; and when, B.C. 283, P. Cornelius Dolabella had beaten both them and their Gallic auxiliaries in a decisive and sanguinary battle at the Vadimonian Lake, Etruria became a Roman province; and about 200 years later, the Lex Julia conferred upon her inhabitants, as a reward for their fidelity, the right of citizenship. Till that time, they had succeeded in keeping up their own singularly distinct creed, customs, traditions, language—their nationality, in fact; when Sulla, B.C. 82, infuriated by the part that they had taken against him, liberally bestowed great portions of their land upon his veterans; and abt. 50 years later, Octavianus planted his military colonies there. This wrought and completed the transformation of that mysterious conglomeration of heterogeneous races and tribes, hitherto called Etrurians, into Romans. Once more, well nigh 2,000 years after its extinction, the kingdom of Etruria (Hetruria) rose before the eyes of the world. The peace of Luneville re-created it, and conferred it on the hereditary prince, Louis of Parma; after whose death, his widow, the Infanta Louisa of Spain, administered the government for their son, Charles Louis, till 1807, when it became a French province. From 1809, it again bore the name of the Grand Duchy of Tuscany. For its modern history, see TUSCANY: ITALY.

Twelve cities are spoken of above as forming the confederacy of Etruria Proper. Similar confederacies of 12 cities were established, independently of each other, in the two other Etrurias. The cities themselves, however, cannot be definitely named now in all cases. From the fact of more than 12 autonomous ones being recorded in Etruria Proper, it would appear that some among these 12 confederates, or *populi*, possessed more than one capital city, each *populus*, however, being limited to one representative vote in the general council. The members of the confederacy were bound to appear regularly at an annual religious assembly near the temple of Voltumna, whose locality is not known. Here great fairs were held for the people; common operations of war being discussed by the *principes*, and a gen.-in-chief for the ensuing year elected from their number. Each city or canton, in the earlier times at least, had a king (Lucumo, Lauchme = Inspired), chosen for life, who at the same time acted as high-priest; and a hereditary nobility, which alone was eligible to the higher offices of state. Next to them, in the political and social scale, came the people properly so called—free, not subject personally to the nobility; lowest stood a great number of clients or bondmen, probably descendants of subjected original inhabitants. On the whole, the federal interdependence between the cities was far from close. Single cities carried on wars in which the others took no part; and when the

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coufederacy resolved on general action, there were always some members which, for one reason or other, stood aloof. It appears from this that the Etruscan constitution was analogous to the Greek and Roman in their earliest stages: the community develops itself into a *polis* or city, chooses a head, or rather high-priest, and enters into a more or less intimate alliance with its neighboring cities; but, besides that king of its own, recognizes a common chief only in time of war.

The Etruscans were, as a people, less warlike than any of their neighbors, especially the Romans, and conspicuous is their want of anything like cavalry. Theirs was also the un-Italic custom of hiring soldiers, and their energies seem to have been directed principally to the more profitable occupations of trade and agriculture. One of the chief articles of their commerce was amber, which Germans brought from the Baltic to Etruria Circumpadana, whence it was conveyed to Greece by sea. In the w. parts of the Mediterranean, they were formidable as pirates; while they were welcomed by the Carthaginians and the Greeks of Magna Græcia, as importers of indigenous products of nature and art, which they exchanged for the wealth of the East and South. That their commerce within Italy must have been very extensive, appears from the fact that all the states of Central Italy adopted their system of coinage, based, like their tables of weights and measures, and many of their political institutions, on the duodecimal system.

The striking contrast between the Etruscans and their Italic and Greek neighbors, which appears in the short thickest frames, the large heads and bulky extremities of the former, and the slender limbs and graceful harmony in the whole structure of the latter, and which runs with equal distinctness through the intellectual lives of the three nations, manifests itself nowhere with greater power than in their religions. Equally distant from the abstract, clear rationalism of the Latins, and the plastic joyfulness of Hellenic image-worship, the Etruscans were, as far as their dumb fragments show—for what we find on them of human words we do not understand—chained in a dark and dotard mysticism, such as might be produced from a blending of a half-forgotten Eastern symbol-service with barbarous religious practices of northern savages, grafted upon archaic Greek notions. In their Pantheon, the predominance belongs to the evil, mischievous gods; their prisoners are welcome sacrifices to the heavenly powers; they have no silent depths where the ‘good spirits’ of their departed dwell, but a hell of the most hideous description, and a heaven where permanent intoxication is the bliss that awaits the virtuous. They divided their gods into two classes, and they place them in the most northern, therefore most immovable point of the world, whence they can best overlook it. The upper section is formed by shrouded, hidden gods (*Involuti*), of uncertain number, who act awfully and mysteriously, and 12 lower gods of both sexes, called *Consentes*, *Complices*. *Tinia* (*Zeus, Jupiter*) is the

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chief of these latter, and stands between the two divisions of the gods, receiving orders for destruction from the upper ones, while the lower ones form his ordinary council, and obey his behests. Nine of these (Novensiles) hurl lightnings at various times and with peculiar effects. The three of these deities which seem to have been the principal objects of worship were Tinia himself, armed with three different kinds of lightning, Cupra (Hera or Juno), and Menrfa (Minerva, Pallas Athene). Gods most peculiarly Etruscan are Vejovis, an evil Jupiter, whose thunderbolts have the power to deafen, and Nortia, the goddess of Fate, called also Lasa Mean. Besides these, they put a host of demons over the different portions of the creation: the heavens, the earth, and the lower regions (Penates, Lares, and Manes). Their deities generally have wings; and before the Assyrian bulls had come to light, some antiquaries established from this a connection with the Hebrew winged cherubim. Characteristic in the highest degree is their 'disciplina' or art of 'divination.' This had been revealed by Tages, grandson of Jupiter, who, according to the myth, was dug out near Tarquinii, in the shape of a childlike dwarf with gray hair—a most striking caricature of these both childish and senile practices—and who died immediately after having communicated these mysteries. They were at first the property of the noble families; but in the course of time, as others were initiated, and schools for priests were founded, these mystical and awe-striking teachings came to be written down. It is saddening to observe here again in what monstrous insanities the spirit of man occasionally revels, and that, too, in the province of what is noblest and highest—religion. The 'disciplina' was developed into an exact science, fully as minutely and casuistically sharpening its points and splitting its hairs as Hindu or Mohammedan theology would. It taught what gods hurled the different kinds of lightning; how, by the color and the peculiar quarter of the sky, the author of the bolt might be recognized; whether the evil denoted was a lasting or a passing one; whether the decree was irrevocable or could be postponed; how the lightning was to be coaxed down, and how it was to be buried. This was the specialty of the Fulgurales. The Haruspices had as their share the explanation of portents, prodigies, monsters, the flight and cries of birds, the entrails of sacrificial animals; while others ministered in the holy rites at the foundation of cities, the building of gates, houses, etc. Their ceremonies (a word derived from their town Cære) were endless and silly, but the show and pomp with which their priests knew how to surround these juggleries, and from which the Romans largely borrowed, made them acceptable in the eyes of the herd; and though Rome herself, with all her augurs, called Etruria 'the mother of superstition,' there was a certain odor of tithes and fees about these rites which made many anxious to 'preserve religion in its primeval purity.'

In the entire absence of anything like a genuine Etruscan account, even the outlines of the relation between their

religion and that of the Greeks on the one hand, and the Romans on the other, are exceedingly difficult to trace ; so much, however, is certain, that they adopted and assimilated many points of archaic Greek theology, and clothed them in a garb of their own, and that this process was repeated still more completely by the Romans in their turn, with respect to the religious notions of the Etruscans. See GREEK RELIGION : ROMAN RELIGION, ANCIENT.

The high civilization which the Etruscans possessed long before Rome was heard of, is testified by innumerable works of masonry and art. The Etruscans were of an eminently practical turn of mind, and domestic, like the northern nations. Trusting to their priests for reconciliation with the gods, who seemed always irate, but whose angry decrees could easily be foreseen and averted, they set to work in developing the inner resources of the country, and in making the best use of their intercourse with foreign countries. They thus became eminent in agriculture, navigation, military tactics, medicine, astronomy, and the like ; and in all these, as well as in some of the minutiae of their dress and furniture, the Romans became their ready disciples and imitators. The division of the year into 12 months, of the months into kalends and nones and ides, the designation of the numerals, were Etruscan ; from the same source were derived the *toga prætexta* as well as the pomp of triumphs, the *lictors* and *apparitors*, down to the ivory curule chairs. The towns of the Etruscans were clean and healthful, owing to their perfect system of drainage and sewerage ; they tunneled and excavated, they embanked and irrigated, they turned swamps into cities, changed the course of streams, and excelled in various kinds of useful public and private works. Their ideal was not the beautiful or the spiritual, but a comfortable, and, if possible, luxurious existence. As a special proof of their love for their own hearth, a quality imported probably from the north, we might adduce their invention of the atrium, the common sitting-room of the family, where the master of the house sat surrounded by his penates and the figures of his ancestors, while the wife and her handmaidens plied the labors of the loom or the distaff. As in the Germanic nations, woman stood in high estimation. She was the companion, not the slave, of the husband, and thus had certainly not a little share in the softening of their primitive wildness, and in countering the sombreness of their creed. The fact that even in their tomb-paintings they are seen engaged in convivial carousings, dancing, races, athletic games, and that they liked that their very worship should be accompanied by the sound of flutes, horns, and trumpets, only shows that that glorious sky of theirs, their intercourse with the nations, their wealth and culture, had gradually caused their antique and gloomy austerity to wear off, even as it wore off with the Romans and other peoples ; for to assume with some that the boisterous scenes referred to were caused more or less by the despair arising from the loss of their independence, would be going too far. Lasciousness is the sure forerunner of the fall of a nation, but a

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whole people does not take refuge in enjoyment when their all is lost. We know little of Etruscan literature; it seems to have consisted mostly of rituals, religious hymns, and some historical works. Whether the Fescennines, certain mocking-songs, sung in alternate verses, with musical accompaniment, at nuptials, originated with them or not, is not decided.

We have alluded to the high proficiency of this people in architecture; they were, in fact, so renowned in this craft throughout the antique world, that, as Solomon called Phœnicians to Jerusalem to build his temple, so the Romans sought in Etruria the framers of their grandest masonic structures, such as the Cloaca Maxima, the Temple of Jupiter on the Capitol, etc. The peculiarly fantastic and, withal, powerful mind which speaks in all their institutions equally pervades their architectural productions; but, at the same time, everything that they built, they built either for practical or pious purposes. Their manner, differing in various epochs, never reached anything like a distinct national completeness, their eagerness to profit by foreign examples not allowing them to develop it to the full unalloyed. Of their walls and gates, temples and porticoes, theatres and amphitheatres, bridges and sewers, gigantic, and, in the earliest times, cyclopean—erected, in Eastern fashion, evidently by hosts of slaves—very little is extant in so complete a form as to afford exact insight into their mode of construction; and were it not for their tombs, our knowledge would be exceedingly limited. These form one of the most peculiar features in Etruscan antiquities. Hewn in rocks, either below the ground or in the face of a cliff, they were adorned outside with a somewhat Egyptian façade of a temple or a house, which semblance of a house the insides most exactly reproduce, with all their internal decorations, furniture, and utensils. Of the paintings around the walls, which are our safest and most complete guides to the inner life of this nation, more is said below. Their temples bore in primitive times, and always retained in some measure, so far as we can judge, the unfinished character of the wood-buildings of the northern mountain tribes—a squire, half-house, half-fortification, overloaded with quaint ornamentation.

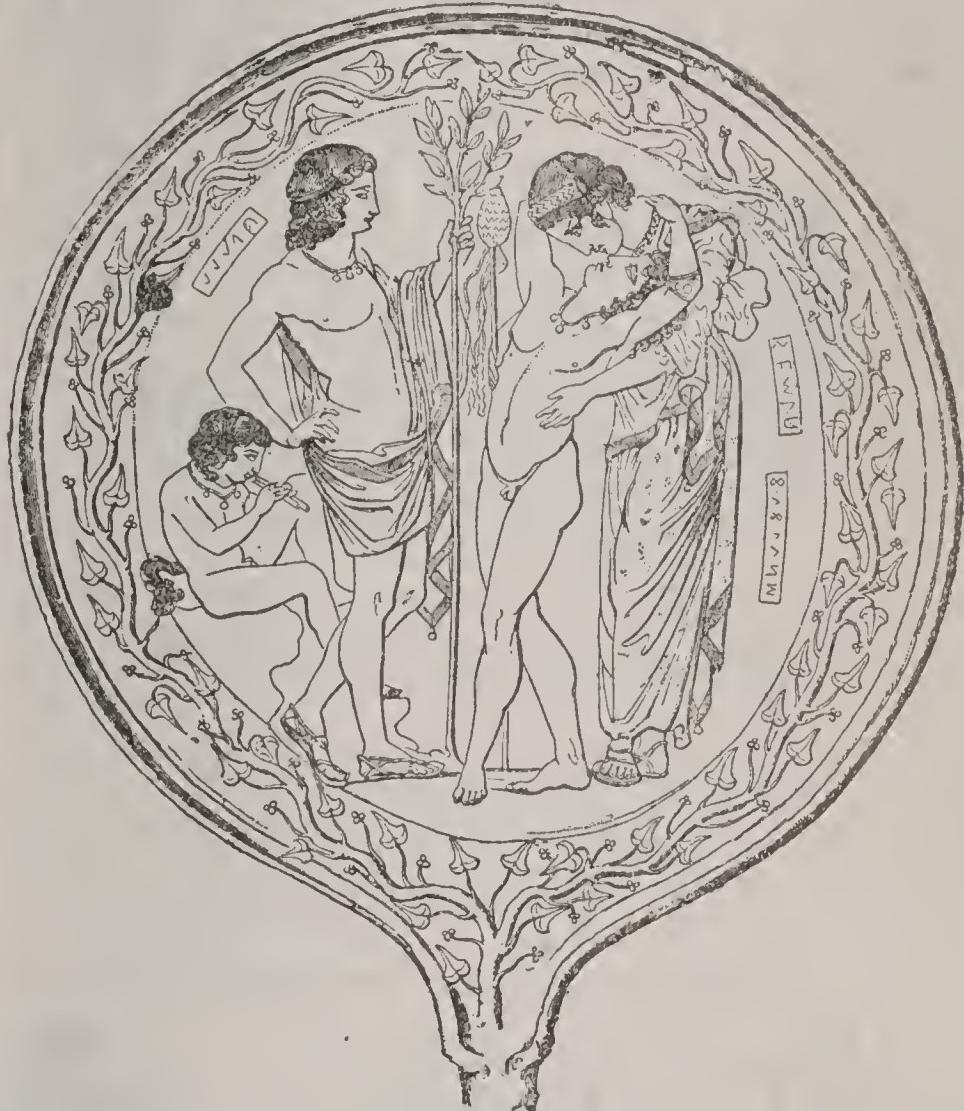
In their plastic and pictorial arts, Winckelmann has established three distinct styles—to which Dennis has added a fourth—viz., the Egyptian, with Babylonian analogies, the Etruscan or Tyrrhene proper, the Hellenic, and that of the *decadence*. Characteristic of the first style are the prevalence of straight lines, right angles, faces of an oblong, contracted oval, with a pointed chin, eyes mostly drawn upward, arms hanging close to the side, legs close together, drapery long in straight parallel lines, hair disposed in tiers of curls. In this style, the attitude is constrained, the action stiff and cramped. The progress shown by the second style is the greater attention bestowed on the delineation of the muscles, which swell out in disproportionate prominences on the now almost entirely nude body. The two remaining styles explain themselves. Their statuary, as it

appears chiefly on sarcophagi and cinerary urns, likewise suggests an Egyptian origin. The figures are those of their own mystical and awful Hades, instead of the Bacchic processions of Greece and Rome. The grouping follows rather a pictorial than a plastic principle; the motion is hasty and forced; but the features of the deceased, hewn on the lid, have all the rude accuracy of a spiritless portrait. Statues of deities in wood and stone have been found, but very rarely. Of high renown were their ornaments and utensils in baked clay (*terra cotta*), in the manufacture of which objects the Veientes were especially famous. Rome at a very early period possessed of this material a quadriga and the statue of Summanus, made by Etruscans. Of the art of working in bronze, the Etruscans were supposed to be inventors; that they brought it to a very high degree of perfection is evident from the examples which remain. Statues and utensils were manufactured and exported in immense quantities, not only to Rome, but to every part of the known world. Of figures on a large scale still extant are the renowned She-wolf of the Capitol, the Chimæra in the Museum of Florence, the Warrior of Todi in the Etruscan Museum of the Vatican; a portrait-statue of an Orator, with the inscription Aule Meteli, in Florence; and the Boy with the Goose at Leyden. The various objects of ornament and use, found in great numbers in tombs, such as candelabra, cups, tripods, caldrons, couches, disks; articles of armor, as helmets, cuirasses, etc.; musical instruments, fans, cists or caskets, are most of them models of exquisite finish and artistic skill. Their gems are as numerous as those of Egypt, and, like them, cut into the form of the *scarabæus* or beetle. They were exclusively intaglios, of carnelian, sardonyx, and agate. On these the Etruscan artists represent groups from the Greek mythology, or the heroic cycle, lacking, as they seem to have been, in heroic legends of their own. They are found most frequently at Chiusi and Vulci, and were worn as charms and amulets. Special mention should be made of the metal *specula*, or mirrors, with figures scratched upon the concave side, the front or convex side being highly polished. These ranged over all the phases of Etruscan art, and are especially and peculiarly Etruscan. None but Etruscan inscriptions have ever been found on them. They will, no doubt, prove eventually of the highest importance, not only by enabling us to follow the gradations of artistic development step by step, but by furnishing us with lists of names of gods and persons, and, it may be, of objects.

The vases and urns found in innumerable quantities in Etruscan tombs, are admitted on all hands to be, with very few exceptions, Greek, both in design and workmanship (see VASES). The tomb-paintings are found chiefly in the cemeteries of Tarquinii and Clusium; and they are all the more important, as they lead us with minute accuracy from the very cradle of the individual, through the various scenes of his entire life, to its close; and this throughout the existence of the nation itself, beginning before the

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fouudation of Rome, and ending in the Empire; while we follow the style in its gradual development from the Egyptian to Græco-Roman perfection. One of the annexed specimens, taken from a tomb at Corneto, represents a death-bed scene; but most of the other paintings, especially at Tarquinii, are of a very different description, as the other specimens show. Life in its merriest aspects gleams in the most vivid of colors all round—dancing, feasting, loving



Etruscan Mirror from Vulci, with Phuphluns (Bacchus), Semla (Semele), and Apulu (Apollo).

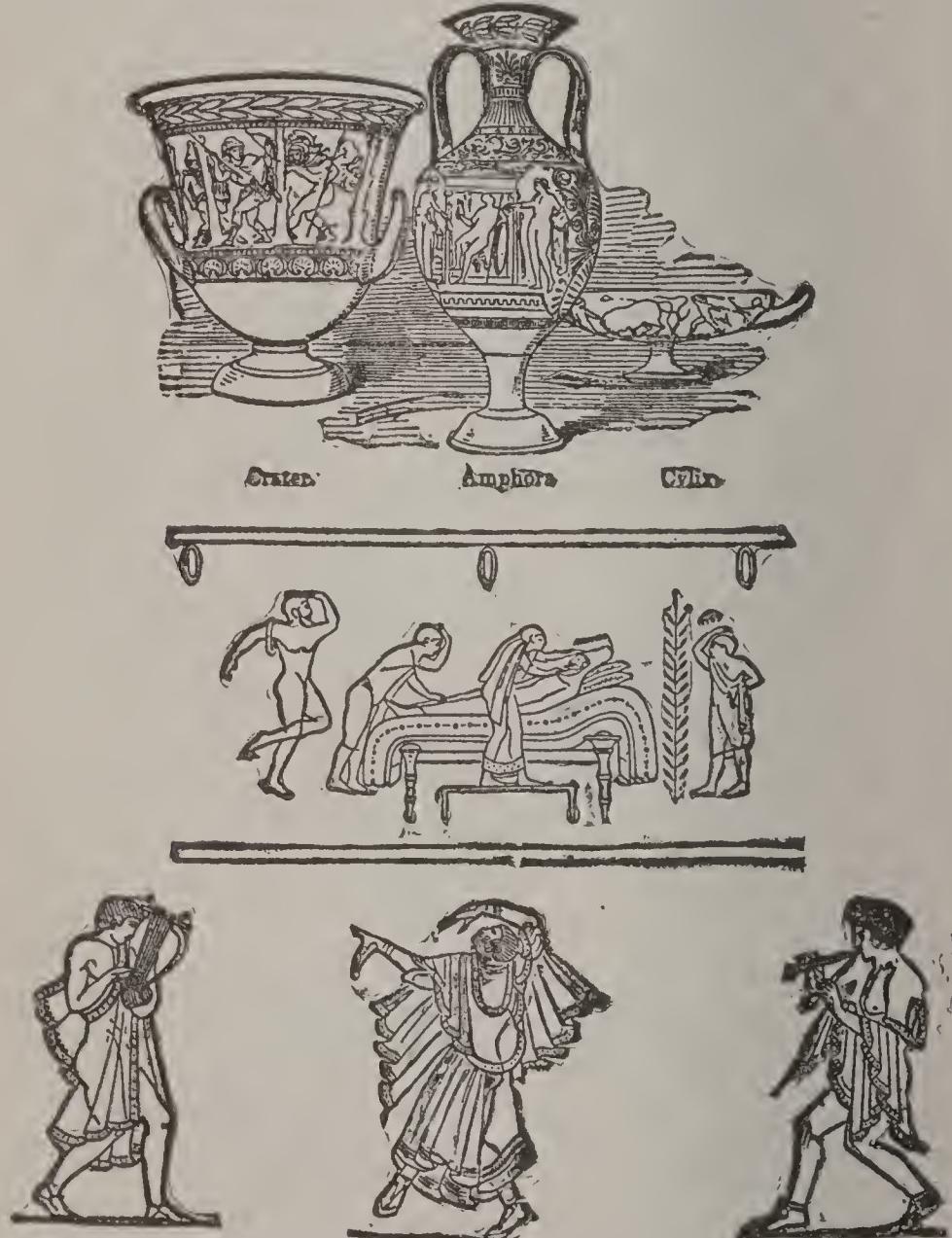
After a drawing by Mr. George Scharf.

hunting. The Etruscans of later times had learned in the school of the Hellenes to dread death less, and to think of the other world as one of continued joyfulness.

The Etruscan language is preserved in more than 3,000 inscriptions, and this number will no doubt be doubled by the opening of new sepulchral chambers, with which the soil of ancient Etruria is teeming. These inscriptions are found on sarcophagi, urns, vases, columns, statues, and mirrors in bronze. The latter article was a favorite object for the representation of scenes from Greek mythology, and from this source we learn the names of the principal native deities. *Tinia* was Jupiter; *Usil*, the sun; *Fufluns*, Bacchus;

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Sethlans, Vulcanus; *Thurms*, Mercurius; *Turan*, Venus; *Thalna*, Juno; *Thesan*, Aurora. Some of the minor female deities are called *Lasa*, *Maris*, *Mean*, *Vanth*. The inscriptions are of two kinds—the archaic and the more recent. The former, generally beginning with the syllable MI, are distinguished not merely by a more ancient form of the alphabet, but also by a more refined condition of the language. In the older inscriptions consonants and vowels are evenly balanced. But in the documents of later date, short vowels are generally omitted, and, in consequence, combinations of conso-



nants appear which remind us strongly of the cacophonous forms of some of the Slavonic languages. Compare the following specimens: 1. *Mi Tesantaia Tarhumenaia*. 2. *Laris Sesctna Lumscial*.

With regard to the grammar, the following points may be considered as established. In the singular of nouns, the nominative ends in *s*; the genitive, according to the class of declensions, in *a-s*, *e-s*, *i-s*, *u-s*; the dative in *si* or *s*. But these terminations are very often dropped, as in early

ETRUSCAN LANGUAGE—ETTMÜLLER.

Latin. In the Cippus Perusinus, both the largest and best preserved inscription of all now in existence, we find of the proper names Velthina and Afuna the cases: *Velthina*, *Velthinum*, *Velthinas*; *Afuna*, *Afunam*, *Afunas*. The suffix *al* serves mostly, but not exclusively, for the expression of a metronymic: *Thana Seianti Latinia*, for example, is *Thana Seiantia, daughter of Latinia*. Another very common suffix—*asa*, *esa*, *isa*, *usa*—designates the matrimonial relation of women: *Thana Aulnei Canzna* is *Thana Aulneia, wife of Canzna*; *Tha Setumnei Pumpunisa* is *Thana Setumneia, wife of Pomponius*. It is clear that this suffix consists of the genitives in *as*, *es*, *is*, *us*, with the addition of an *a*, so that grammatically and logically the wife is defined as part and parcel of her husband. Verbal forms do not occur often, but it is certain that the preterite is formed from the root by the addition of the syllable *ce*, like *tur-ce*, *the-ce*, *lupu-ce*, *sval-ce*. The numerals sound rather strange. *Mach*, *thu*, *zal*, *huth*, *ki*, *sa*, are 1–6; but as yet the individual meaning of each of these is unknown. The same must be said of *sesphs*, *esal*, *mu* or *muv*, the numerals for 7–9. Decades are expressed by *alch(a)l*, e.g., *sespalchal*, *muvalchl*, *ceatchl*. 90 was probably *zathrums*. The meaning of about 10 or 12 words, such as *clan*, son; *sech*, wife; *avil*, age; *vr̄l*, year; *hinthial*, spirit; *fieres*, statue, can be clearly established; but as yet no affinity has been discovered between these and the corresponding expressions in Aryan or other languages. The following two inscriptions are given with a translation which in one or two points is conjectural:

Vipia Alsinaï turce Versenas Caiia.
Vibia Alsinea dedit Versenæ, Caiæ filiæ.

The second is found on the celebrated bronze statue of the orator, now in the museum of Florence;

Aulesi Metelis Ve Vesial clensi cen fieres tece
Aulo Metello Veliæ Vesiae filio hoc signum posuit
sansl tenine tuthines chisulics.
jussu concilii publici magistratus (?).

The few bilingual inscriptions (altogether 15) throw no light on the language, as they contain only proper names. The so-called Tyrrhenian glosses, preserved in the lexicon of Hesychius, are worse than useless for critical purposes.

ETRUSCAN LANGUAGE: see ETRURIA.

ETSCH: see ADIGÉ.

ETTER-PIKE, n. *ĕt'ér-pik* [AS. poison]: the lesser weaver or sting-fish, *Trachinus vipera*. ETTER-CAP, n. *-kăp*, a spider; hence figuratively, a virulent, atrabilious person.

ETTLE, v. *ĕt'l* [Icel. *atla*, or *atla*, to purpose]: in *Scot.* and *Irland*. *Eng.*, to purpose; to design; to aspire; to expect; to attempt. ETTLING, imp. *ĕt'ling*. ETTLED, pp. *ĕt'ld*.

ETTMÜLLER, *ĕt'mü'l-ĕr*, ERNST MORITZ LUDWIG: 1802, Oct, 5—1877, Apr.; b. Gersdorf, in Upper Lusatia: writer on German antiquities. He studied medicine at Leipsic 1823–26,

ETTRICK—ETTY.

but subsequently the language and history of his native country. In 1830, having taken his degree Ph.D. at Jena, he began to deliver lectures there on the German poets of the middle ages; in 1833 he was called to the Zürich Acad. and in 1863 to the univ. there, as prof. of German literature. E.'s literary activity has been chiefly in the editing of the literary remains of the Middle High-German and older Low-German dialects. To the former belong his *Sant Oswaldes Leben* (Zürich 1835); *Hadeloubes Lieder und Sprüche* (Zürich 1840); *Heinrich's Von Meissen des Frouwenlobes Lieder, Leiche, und Sprüche* (Quedlinb. 1834); *Frouwen Helchen Süne* (Zürich 1846); *Heinrich's Von Veldecke Eneide* (Zürich 1852). Of poems in Low German he published, among others, *Theophilus* (Quedlinb. 1849); and *Wizläues IV., des Fürsten Von Rügen, Lieder und Sprüche* (Quedlinb. 1852). In 1850 appeared, under his editorship, an Anglo-Saxon chrestomathy; in the following year his much-valued *Lexicon Anglo-Saxonicum*. E. studied also old Norse literature, as is shown by an edition of the *Völuspá*, translations, and a Norse reading-book. He wrote several original poems: his *Deutsche Stammkönige* appeared at Zürich 1844; his *Kaiser Karl d. Gr. und das Fränkische Jungfrauenheer*, 1487; and his *Karl d. Gr. und der Heilige Goar*, 1852; *Herbstabende und Sommernächte* are essays on his favorite subjects (3 vols. 1865–67).

ETTRICK, *et'rɪk*: pastoral vale in the s. of Selkirkshire, Scotland, watered by the Ettrick river, which rises amid bleak hills in the s.w. corner of the county near Ettrick Pen, 2,258 ft. high, flows 28 m. n.e. and falls into the Tweed. Its chief affluent is the Yarrow, which runs 25 m. from the w., through one of the loveliest of Scotch vales, and the scene of many a plaintive song. Ettrick Forest, a royal hunting tract, swarming with deer till the time of James V., included Selkirkshire and some tracts to the north. In Ettrick Vale, at Tushielaw, dwelt the celebrated freebooter or king of the Border, Adam Scot, who was summarily put to death by James V. The district derives some note from two persons in modern times—Thomas Boston (q.v.), minister of the parish of Ettrick; and James Hogg, poet, who, having been originally a shepherd in this part of the country, became known as ‘the Ettrick Shepherd.’

ETTRINGITE, n. *et'tring-it* [named from *Ettringen*, on the Rhine, where it occurs]: in mineral., name given by Lehmann to a hydrated sulphate of lime and alumina. Crystallization hexagonal. In minute needles in limestone inclosures of a lava.

ETTY, *et'i*, WILLIAM, R.A.: 1787, Mar. 10—1849, Nov. 30; b. York, England: artist. His father was a miller and spice-maker. Before he was 12 years of age, he was apprenticed to a printer, and served out his term of seven years of drudgery. Freed at last, and assisted by some relatives, in 1805, at the age of 18, he entered on the study of art, and, after a year's probation, was admitted a Royal Acad. student. For a series of years he was

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invariably surpassed by many fellow-students, and, as has been recorded, ‘looked on by his companions as a worthy plodding person, with no chance of ever becoming a good painter.’ Neither prizes nor medals fell to his share as a student; and for several years his pictures were rejected at the Royal Academy and British Institution Exhibitions. After six years of hard study he obtained a place for a picture in the Exhibition of the Royal Acad. and his works began to attract notice in 1820, when the artist was 33 years of age. The lack of early appreciation arose not so from his works evincing no talent, as from his class of subjects, and his unusual technical qualities; for long before his pictures were saleable, his powers were highly appreciated by his professional brethren. On his return from Italy, 1822, where he had been studying the great Venetian colorists, he was elected an Assoc. of the Academy. In 1824, his *chef-d'œuvre*, *The Combat—Woman pleading for the Vanquished*, was purchased by an artist, John Martin. In 1828, he was elected Academictan by the members of the Royal Acad. in the same year the Royal Scottish Acad. purchased his most important effort, the historical work illustrating the history of Judith and Holofernes. From that time E.’s pictures came into great request, and brought large prices. He always loved York, his native city, and had retired there some time previous to his death.

E. had an exquisite feeling for color, generally chose subjects that afforded scope for it, in which the nude and rich draperies were displayed. Though carelessness and incorrectness may often be observed in his drawing, it frequently shows elevation and largeness of style. He executed nine pictures on a very large scale, viz : *The Combat*; series of three pictures illustrating the delivery of Bethulia by Judith; *Benaiah slaying two Lion-like Men of Moab* (these five, the best of his large works, were purchased by the Royal Scottish Acad); *The Syrens*, now in the Manchester Institution; and three pictures illustrating the history of Joan of Arc. His smaller works are numerous. Besides his large works he sent for exhibition to the Royal Acad. and British Institution, 1811–49 no less than 230 pictures. The following may be particularly noted: *The Coral-finders*; *Venus and her youthful Satellites arriving at the Isle of Paphos*; *Cleopatra’s Arrival in Cilicia*; a composition from the 11th book of *Paradise Lost* (*Bevy of Fair Women*); *The Storm*; *Sabrina*; *The Warrior Arming*; *Youth at the Prow, and Pleasure at the Helm*; *The Dance*, from Homer’s description of Achilles’s Shield; *Britomart redeems Fair Amoret, Dance on the Sands, and yet no Footing seen*; *Amoret Chained*.—See E.’s Life by Gilchrist (Bogue, London 1855).

ETUI, or ETWEE, n. *ét-wé* [F. *étui*, a sheath]: pocket-case for pins, needles, etc.; lady’s reticule.

ETYMOLOGY, n. *ět’i-mől’ō-jǐ* [L. *ětymolōgiā*—from Gr. *etūmōs*, true; *logos*, a word: L. *etymon*; Gr. *etumon*, the true source of a word: F. *étiologie*]: department of the

study of language which traces words to their elements, their original forms, and primary significations. **ET'YMOL-**
OGIST, n. one who. **ET'YMOLOG'ICAL**, a. -mō-lōj'i-kāl, pertaining to etymology. **ET'YMOLOG'ICALLY**, ad. -lī. **ET'YMOL-**
OGIZE, v. -mōl'ō-jīz, to search into the origin and primary meaning of words. **ET'YMOL'OGIZING**, imp. **ET'YMOL'**
OGIZED, pp. -jīzd. **ETYMON**, n. ēt'i-mōn, an original or primitive word; a root.—*Etymology* is that part of grammar that treats of the derivation of words. It embraces the consideration of the elements of words, or letters and syllables, the different kinds of words, their forms, and the notions that they convey; and lastly, the modes of their formation by derivation and composition. Etymological inquiries have been a favorite pursuit from the earliest times. In the book of Genesis, numerous indications are given of the derivation of proper names. Homer also attempts etymologies of the names of gods and men, which, however, are only more or less ingenious fancies. The grammarians of Alexandria and Varro among the Romans tried to base their etymologies on something like principle; but the wildest conjectures continued to be indulged in, and the results were little better than guess-work, till a very recent period. As philology extended its sphere, and became acquainted with the languages and grammarians of the East, who far excelled those of the West in this particular, etymology took on a new form. It no longer sought the relations of the words of a single language exclusively within itself, but extended its view to a whole group, e.g., the Teutonic, or wider still, to a whole family, as the Indo-European, or Aryan (q.v.), and became a new science under the name of Comparative Grammar. See **PHILOLOGY**.—*Etymologicum Magnum* is the name of a Greek lexicon, the oldest of the kind, professing to give the roots of the words. It appears to belong to the 10th c.; the author is unknown. The etymologies are mere guesses, sometimes right, often wildly absurd; but the book is valuable, as containing many traditions and notices of the meanings of old and unusual words. There is an edition by Schäfer (Leip. 1816); one by Sturz, *Etymologicum Gudianum* (Leip. 1818); another by Gaisford (Oxf. 1849).

EU, prefix, ū- [Gr.]: well; happily; prosperously; safely; it is used frequently as a prefix in English with the force of well; good; easy, etc.

EU, ūh: moderately well-built town of France, dept. of the Lower Seine, Normandy, near the mouth of the Bresle, 93 m. n.n.w. of Paris. It is remarkable for its fine Gothic church, and for the Château d'Eu, a low building of red brick, with high tent-shaped roofs of slate. E. manufactures sail-cloth, ropes, soap, lace, and silk. In the 11th and 12th c. E. was in the possession of the counts of the same name, collateral branch of the Norman royal family. After various vicissitudes, it was purchased by Mademoiselle de Montpensier 1675, whose fanciful taste has perpetuated itself in the architecture and decoration of the château. Later, it came into the possession of the Duke of Maine,

EUASTRUM—EUBOTRYS.

from whom it passed to the Duke of Penthièvre, maternal grandfather of Louis Philippe, who succeeded to it 1821. Louis Philippe expended large sums on the embellishment of the château, especially on its magnificent park and the unique portrait-gallery. The eldest son of the Duke of Nemours (b. 1842, Apr. 29) received from his royal grandfather the title of Count d'Eu. He married (1864) Isabel, heiress-apparent of the throne of Brazil; and was commander-in-chief of the Brazilian army in the war with Paraguay, 1869. Compare Vatout, *Le Château d'Eu, Notices Historiques* (5 vols. Paris 1836); his *Résidences Royales* (Paris 1839).—Pop. 5,000.

EUASTRUM, n. *ū-ăs'trūm* [Gr. *euasteros*, rich in stars; *eu*, rich or abundant in; *asteros*, a star]: in bot., genus of algals, sub-order *Desmidieæ*.

EUBŒA, *ū-bē'a* (ancient, *Euboia*; Turkish, *Egripo*; Ital. *Negroponte*): largest island in the Aegean Sea; a portion of the present kingdom of Greece. Until recently, it was called Negropont. It is bounded n. by the Trikeri Channel, and w. by the channels of Talanta and Egripo. It extends in a direction parallel to the mainland; is 105 English statute m. long, and 30 m. in extreme breadth, though in one part its breadth is scarcely four miles. At the narrowest part, it is connected with the mainland by a bridge. The island is intersected by a chain of mountains, running n.w. and s.e., and attaining in the centre, in the range of Mount Delphi, an elevation of about 4,500 ft. Copper and other metals are obtained in the island, which contains also numerous hot springs. The pastures are excellent, and the declivities of the mountains covered with forests of fir-trees. The climate is salubrious, the valleys well watered and very fertile, but little cultivated. The chief products are cotton, oil, wine, wheat, fruit, and honey. The inhabitants are engaged chiefly in the breeding of cattle; they export wool, hides, and cheese, as well as oil and grain. The chief towns are Chalcis (q.v.) on the n., and Carystos on the s. coast, the latter having a pop. of 3,000. E. was peopled in early historic times chiefly by Ionic Greeks, afterward by colonists from Athens, who formed a number of independent cities or states. These were at first monarchical in their constitution, but at a later period democratic. They soon rose to power and prosperity. After the Persian wars, however, E. was subjugated by the Athenians, under whose rule it continued till they were subdued by Philip of Macedon. By the Romans, it was finally united with the province of Achaia under Vespasian. In 1204, it came into the possession of the Venetians, and received the name of Negroponte. In 1470, the island was taken by the Turks, in whose hands it remained till 1821, when the inhabitants rose to vindicate their independence at the call of the beautiful Modena Maurogenia. It now forms a portion of the modern kingdom of Greece.—Pop. (1879) 95,136; (1896) 115,515.

EUBOTRYS, n. *ū-bōt'rīs* [Gr. *eubotrus*, rich in grapes; *eu*, rich or abounding; *botrus*, cluster or bunch of grapes]:

EUCAIRITE—EUCALYPTUS,

in bot., genus of *Ericaceæ*. *E. arborea* (formerly *Lyonia arborea*) is the sorrel-tree of America, the acid leaves of which are chewed by hunters to assuage their thirst.

EUCAIRITE, n. *ū-kār'īt* [Ger. *eukairit*—from Gr. *eukairos*, seasonable; *eu*, good; *kairos*, the right point of time: named because opportunely discovered]: a soft mineral easily cut by the knife; color between silver-white and lead-gray, lustre metallic, structure massive and granular, or in black metallic films. Composition: selenium, 31·6; copper, 25·3; silver, 43·1 = 100. It is found in Sweden, Chili, etc.

EUCALYN, n. *ū-kāl-īn* [Eng. *eucalyptus*, suff. *-in*]: in chem., unfermentable sugar, which separates in the fermentation of melitose (the sugar of *Eucalyptus*). It is a thick syrup, which polarizes to the right, and does not reduce copper solution.

EUCALYPTOCRINUS, n. *ū-kū-lip-tō-kri'nūs* [Gr. *eu*, well; *kaluptos*, covered; *krinon*, a lily]: in paleon., typical genus of the family *Eucalyptocrinidae*. The calyx is inverted upon itself, whence the name of the genus. It ranges in time from the Silurian to the Devonian rocks.

EUCALYPTOL, n. *ū-kū-lip'tōl* [Eng. *eucalyptus*; L. *oleum*, oil]: in chem., volatile oil obtained from *Eucalyptus globulus*. It contains 70 per cent. of eucalyptene and 30 per cent. of cymene.

EUCALYPTUS, n. *ū-kā-lip'tūs* [Gr. *eu*, well; *kaluptō*, I cover]: genus of trees of the nat. ord. *Myrtaceæ*, sub-order *Leptospermeæ*, containing a large number of species, natives mostly of Australia, and which, with trees of nearly allied genera, form one of the most characteristic features of the vegetation of that part of the world. The genus occurs also, though much more sparingly, in the Malayan Archipelago. The trees of this genus have entire and leathery leaves, in which a notable quantity of a volatile aromatic oil is usually present. The leaves, instead of having one of their surfaces toward the sky, and the other toward the earth, are often placed with their edges in these directions, so that each side is equally exposed to the light. Many species abound in resinous secretions, and are therefore called GUM-TREES in Australia. Some attain great size; some are found with trunks from 8 to 16 ft. in diameter; a plank 148 ft. in length was exhibited at the Great Exhibition, London, 1851. They are of very rapid growth; and their timber, when green, is soft, so that they are easily felled, split, or sawn; but when dry, it becomes very hard. It is used for a great variety of purposes, among which is ship-building. The bark of many species abounds in tannin, and has become to some extent an article of commerce. Some kinds of it are said to be twice as rich in tannin as oak-bark. The bark of some is remarkable for hardness; while some throw off their outer bark in longitudinal strips or ribbons, which, hanging down from their stems and branches, have a very singular appearance.—Among the resinous secretions of this genus is the substance called Botany Bay Kino, used

EUCHARIST—EUCHIRUS.

in medicine as a substitute for kino (q.v.). It is the produce of *E. resinifera*, a species with ovato-lanceolate leaves, known in Australia as the Red Gum Tree and Iron Bark Tree, a very lofty tree, attaining a height of 150–200 ft. When the bark is wounded, a red juice flows very freely, and hardens in the air into masses of irregular form, inodorous, transparent, almost black when large, but of a beautiful ruby red in small and thin fragments. Botany Bay Kino is said to consist chiefly of a peculiar principle called *Eucalyptin*, analogous to tannin. About 60 gallons of juice may sometimes be obtained from a single tree, or, in the course of a year, as much as 500 pounds of kino.—*E. robusta*, Stringy Bark Tree, also lofty, yields a most beautiful red gum, which is found filling large cavities in its stem, between the concentric circles of wood.—*E. manifera* yields, from its leaves, an exudation resembling manna, less nauseous, and of similar medicinal properties. It contains a saccharine substance, different from *mannite*, from *glucose*, and from all previously known kinds of sugar. Another similar exudation, from the leaves of *E. dumosa*, is sometimes seen spread over large districts like snow, and used by the natives as food.—The Tasmanian Blue Gum Tree, one of the Eucalypti, has recently acquired great reputation for its effects in drying marshy soils, and in preventing malarious diseases. It is extremely rapid in its growth, which may account for its drying powers; and this, in its turn, may partly account for its salubrious effects; though its camphor-like odor may also have to do with it. It has been tried with decidedly beneficial effects in the Cape of Good Hope, Algeria, the Roman Campagna, and elsewhere. Unfortunately, it does not bear a severe winter. **EUCALYPTUS GLOBULUS**, *glōb'ū-lūs* [L. *glōbus*, a ball, a sphere]: the blue gum-tree or fever gum-tree, furnishing an astringent bark and a fragrant oil. **EUCALYPTI**, n. plu. *ū'kă-lip'tī*, general name for all the species of *Eucalyptus*.

EUCHARIST, n. *ū'kă-rĭst* [F. *eucharistie*—from L. and Gr. *eucharistiā*, a giving of thanks—from Gr. *eu*, well; *chāris*, favor]: the sacrament of the Lord's Supper; a giving of thanks (see **LORD'S SUPPER**). **EU'CHARIS'TIC**, a. *-kă-ris'-tīk*, or **EU'CHARIS'TICAL**, a. *-tī-kăl*, pertaining to the Lord's Supper.

EUCHEIR'US: see **EUCHIRUS**.

EUCHELAION, n. *ū-kĕ-lā'ōn* [Gr. *euchē*, prayer; *elaion*, oil]: in Gr. chh., oil with which a penitent guilty of a mortal sin is anointed by an archbishop or bishop and seven priests, in order to gain absolution.

EUCHEUMA, n. *ū-kū'ma* [Gr. *eu*, abundant; *cheuma*, that which is poured; & flood]: in bot., genus of rose-spored *Algæ*.

EUCHIRUS, n. *ū-kī'rūs* [Gr. *eucheir*, with good hands; handy; active; dexterous; *eu*, well developed; *cheir*, the hand: so called from the exceeding elongation of the anterior tibiæ and tarsi]: in entom., the name given by Kirby

EUCHITES—EUCHRE.

to a genus of lamellicorn beetles, placed by Swainson in the family *Cetoniadæ*, sub-family *Megasominæ*.

EUCHITES, n. *ū'kīts* [Gr. *euchomai*, to pray]: in *chh. hist.*, a Christian sect which arose in the 4th c., though some of their tenets were older than themselves. Their name was derived from their belief that there dwelt in man a demon who could be expelled only by incessant prayer and singing. They combined with this view various opinions derived partly from Manicheism, partly from the Oriental philosophy. After a time the term Euehite became a vague one, applied to all who withdrew from the Catholic Church and spent much time alone in prayer. They were called also Massalians.

EUCHLANIDOTA, n. *ū-klān-ī-dō'ta* [mod. Gr. *euchlanidos*]: in *zool.*, family of rotatoria. The rotatory organs are multiple, or divided into more than two lobes; a carapace is present. There are 11 genera. EUCHLA'NIS, n. *-klā'nīs* [Gr. *eu*, well; *chlānis*, an upper garment of wool]: in *zool.*, typical genus of the family *Euchlanidota*.

EUCHLORINE, *ū'klo-rīn*: very explosive green-colored gas, possessing bleaching properties; prepared by heating gently a mixture of 2 parts hydrochloric acid, 2 of water, and 1 of chlorate of potash. It explodes when merely touched with a hot wire, and is most likely composed of a mixture of chlorine and chloroehloric acid ($2\text{ClO}_5, \text{ClO}_3$).

EUCHOLOGION, n. *ū'kō-lōjī-ōn*, or EUCHOLOGY, n. *ū-kōlōjī-ōjī* [Gr. *euchōlōgīōn*, a prayer-book — from *euchē*, prayer, vow; *lōgōs*, speech, word]: a formulary of prayers; a liturgy.

EUCHRE, *yō'ker* or *ū'kér*: game usually played with 32 cards (all of the pack below the 7-spots being thrown out), by 2, 3, 4, and 6 persons or any number of groups of 4. Common E. has been extended so that the word E. now comprises Railroad E., Set-Baek E., Napoleon, French E., and Progressive E., in each of which the number of cards and players and the style of playing varies. The most popular form, known as E., is played by 2 or 4 persons. In the latter the players take sides as partners either by choice or by 2 matching on the cut of the cards. In 3-handed E., 2 play and the third counts with the winner of each hand, each player engaging in every third hand. In E. the cards have the same values as in whist, in suits not trumps, ace highest, seven lowest; but in the trump suit, the knave of the suit turned up, called the *right bower*, is the highest trump, and the other knave of the same color, called the *left bower*, is the next highest. The ace of the suit ranks third, and the king and queen follow respectively. Thus, a heart is turned, or made trump, the knave of hearts is highest, knave of diamonds next, and ace, king, and queen of hearts follow. Players cut for deal; the lowest takes it, and deals to the left 2 cards around, and then 3; and turns up the first card on the pack, talon, or deek, as the remaining cards are variously known. After the first hand the deal passes on the left to each player in rotation, the cutting

EUCHRE.

between hands being by the player on the right of the dealer. The game of each hand is 5 points, represented by as many tricks. Where one side takes all 5 tricks, it has a *march*, and counts 2; 3 tricks are necessary to score 1 point; 4 tricks count no more than 3; and the failure of a player or side which takes up, orders up, or makes trump, to secure 3 tricks, is called a E., and, in common E., gives the opponent 2 points. The object of the play is to win 3 tricks or 5. When 2 play, the non-dealer decides by his hand, whether he will play or not, and either *passes* or *orders up* accordingly. If he passes, the dealer may take up the trump, discarding one card for it, or he also may pass; but if the trump is ordered up, the dealer must obey and discard as before. If the non-dealer and the dealer pass, the latter turns the trump card over, and the non-dealer may make or designate trumps from his hand; if he again passes, the dealer may make trump; and if he declines, both hands are thrown up, and the deal passes to the next player. Where a trump is made from hand, the game proceeds the same as where it is turned up, the non-dealer leads, the dealer plays to it, and the 2 cards (where 2 are playing) constitute a trick; the second player must follow suit if able; if not, he may trump or *throw away*, i.e., play any card he pleases. The highest card of the suit led wins the trick; trumps win other suits; and the winner of the trick leads. In 4-handed E., the partners sit opposite each other. If the first hand passes, the second may *assist*, which means that the dealer (the partner) is to take up the trump. The hand is then played, the player to the dealer's left having the lead, and each playing a card in turn. In this form of the game 4 cards constitute a trick. When a player has a hand with which he believes he can win all the tricks, he may *play alone*, i.e., single-handed, against the two opponents; he also can do so when he or his partner orders up, when his partner offers to assist, or when he takes up or makes a trump. If he succeeds he scores 4 points, if euchered his opponents score 4. Sometimes, as in Railroad E., when a player determines to play alone, one of his opponents agrees to play alone also, and the game is finished by the two players. A dealer or maker of trumps, or the partner of a dealer, may call for his partner's best card, and play alone after discarding, winners and losers scoring 4 as the game results. PROGRESSIVE EUCHRE is a recent development of the game of E., so formulated that a large number of ladies and gentlemen can play it at one time. Progressive E. has become one of the most popular society diversions, and is made the basis for evening parties, with the accompaniments of prizes, music, etc. The game is played the same as four-handed E., with 5 points. Each group of four players occupy a table; hence, if there are 40 players there must be 10 tables. The hostess hands each player a favor, which, attached to the dress or coat, designates the table at which first he or she must sit. When all the company are seated, the game begins at each table at the tap of a bell, and when that at the first table is finished all stop playing at another tap. The successful players at

EUCHROITE—EUCLID.

the first table retain their seats till after the second game, and the unsuccessful ones are transferred to the last table, at each game the losing partners are moved to the last tables, and the winning ones advance from first to second, third, fourth, etc. Victors add a star, and losers a booby, or green label, to their favors. Various kinds of prizes are provided for the winners of the largest number of honors, gold labels, or stars, as well as for those who receive the largest number of green or booby labels.

EUCHROITE, n. *ū'krō-it*: a bright green mineral of vitreous lustre; its hardness 3·5 to 4; its sp. gr. 3·39. Composition: arsenic acid 32·42 to 34·42; oxide of copper 46·97 to 48·09; water 18·80 to 19·31.

EUCHRONE, n. *ū'krōn* [Gr. *euchroos*, well colored; *eu*, well; *chrōs*, color]: in chem., dark blue insoluble substance formed when zinc is added to an aqueous solution of euchroic acid.

EUCHYMY, n. *ū'ki-mī* [Gr. *euchumia*; *eu*, well; *chumos*, juice; chyme]: in med., a good state of the fluids in the body.

EUCHYSIDERITE, n. *ū-ki-sid'er-it*: same as pyroxene (q.v.).

EUCLASE, n. *ū'klās* [F. *euclase*—from Gr. *eu*, well; *klāein*, to cleave]: prismatic emerald, a fine green mineral found in Brazil and Peru.

EUCLEA, n. *ū'kle-a* [Gr. *eukleia*, good fame; glory; *eu*, good; *kleos*, glory: named from its evergreen foliage]: in bot., genus of *Ebenaceæ*, from Africa.

EUCLID, *ū'klid*: sometimes called the father of mathematics: b. Alexandria, about B.C. 300. We know little more of his history than that he belonged to the Platonic school of philosophy, and taught mathematics in the famous school of Alexandria, during the reign of Ptolemy Soter. Though he did not create the science of mathematics, as is sometimes represented, he made prodigious advances, especially by his rigorous method and arrangement. In this respect he has perhaps never been excelled, and his *Elements of Geometry* at the present day hold their place as a text-book. Besides the Elements, there are extant treatises on music, optics, data, etc., ascribed to E., the authenticity of some of which is doubtful. The best editions of the whole reputed works of E. are those of David Gregory (Oxf. 1703) and Peyrard (3 vols. Par. 1814–18). The oldest Greek edition of the Elements appeared at Basel 1533; the best is that of August (2 vols. Berlin 1826). Of English editions of E.'s Elements, those of Simpson and Playfair are considered best. For full account of everything connected with E. and his works, see Smith's *Dictionary of Greek and Roman Biography*.

EU'CLID, of Megara: d. abt. B.C. 424: Greek philosopher, often confounded with the mathematician of the same name. He was one of the earliest disciples of Socrates. Although Megara lay at a considerable distance from Athens, and all Megarians were forbidden to enter the

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Athenian territories under pain of death, E. came into the city in the evening in female disguise, to enjoy the instruction of Socrates. After the death of his master, he established a school of his own, which received the name of the Megaric School. The basis of his system was the Eleatic dogma of a one, only, universal substance, or existence. Blending with this the Socratic idea of the predominance of the moral element, E. held this one real existence to be *the good*, though it receives various names under its special manifestations.

EUCLIDIUM, n. *ū-klid'ē-ūm* [Gr. *eu*, well; *kleidion*, a little key; *kleidoō*, I lock up: named because the pods are effectively shut]: in *bot.*, typical genus of *Euclididæ*, a family of crucifers, tribe *Pleurorhizeæ*.

EUCNEMIDÆ, n. *ū-nē'mī-dē* [Gr. *euknemis*, well greaved; *eu*, well; *knēmis*, a greave, a legging stretching from the knee to the ankle]: a family of beetles, tribe *Pentamera*.

EUCRASY, n. *ū'kra-sī* [Gr. *eukrasia*; *eu*, well; good; *krasis*, a mixing]: in *med.*, a well balanced temperament.

EUDÆMONISM, n. *ū-dē'mōn-izm* [Gr. *eudaimōn*, happy; *eu*, good; well; *daimōn*, a spirit]: system of philosophy which places the *summum bonum* in the promotion of the happiness of humanity, and teaches that the most virtuous act of which an individual is capable is to render others happy. **EUDÆMONIST**, n. *-ist* [Gr. *eudaimōn*, happy]: believer in eudæmonism. **EUDÆMONISTIC**, a. *-ik*, pertaining to or of the nature of eudæmonism.

EUDIALYTE, or **EUDIALITE**, n. *ū-di'a-līt* [Ger. *eudiulyt*—from Gr. *eu*, easily; *dialuō*, I part asunder, I dissolve; *eu*, well; *luō*, I loosen, I dissolve, in allusion to the facility with which it dissolves in acids]: a rhombohedral red mineral of vitreous lustre, translucent or nearly so; its hardness 5·5; sp. gr. 2·90 to 3·01. Composition: silica, 45·70 to 54·10; zirconia 10·90 to 15·60: sesquioxide of manganese 1·15 to 2·93; sesquioxide of iron 6·37 to 7·86; lime 9·23 to 12·06; soda 11·40 to 13·92, etc. There are two varieties—eudialyte proper, of which the double refraction is positive, and eucolite, in which it is negative. It is found in north Greenland, Norway, and Arkansas.

EUDIOMETER, n. *ū-di'ōm'ē-tēr* [Gr. *eudiā*, fair or fine weather; *metron*, a measure]: instrument introduced as a measurer of the goodness of air in any locality; but now employed generally in the analysis of gases for the determination of the nature and proportions of the constituents of any gaseous mixture. The instrument is now made of glass in the form of a tube, hermetically sealed at one end, open on the other. The tube may be straight, or bent in the shape of the letter U. In either case, the tube is graduated or marked off in equal-sized divisions from the closed end onward, so as to provide accurate measurement of the volume of gas placed within; and two platinum wires are inserted through the glass near the shut end of the tube, and closely approach, but do not touch, each

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other. These wires are intended for the conveyance of electric sparks through any mixture of gases, so as to cause the combustion of certain of them. For the modes of manipulating with the audiometer, see GAS, ANALYSIS OF. EU'DIOM'ETRY, n. -ě-tri, the art or practice of measuring the quantity of oxygen in the air or in a gaseous mixture. EU'DIOMET'RIC, a. -mět'rik, or EU'DIOMET'RICAL, a. -ri-kál, pertaining to.

EUDIOSMEÆ, n. ū-dī ūs'mē-ē: in bot., tribe of *Rutaceæ*, tribe *Diosma*.

EUDOCIA, ū-dō'shī-a: wife of the Byzantine Emperor Theodosius II; d. 460–461. She was daughter of the sophist Leontius or Leon, who instructed her in the literature of Greece and Rome, in rhetoric, geometry, arithmetic, and astronomy. Her accomplishments and singular beauty were reckoned by Leontius a sufficient fortune, for at his death he left all his property to her two brothers. E. appealed to the emperor at Constantinople. Pulcheria, sister of Theodosius, was interested in the maiden, and thought she would make a suitable wife for the emperor. But as E. (or, more properly, Athenais, for this was her name until her baptism) had been brought up a pagan, it was necessary first to convert her. This was easily accomplished. E. was married to the emperor A.D. 421. For many years, however, Pulcheria ruled in the imperial household and councils—E., according to Nicephorus, ‘submitting to her as mother and Augusta;’ but in 447, a quarrel broke out between them in regard to the Eutychian heresy, of which E. had become a supporter. At first, E. was triumphant, and Pulcheria was banished; but in a short time the emperor was reconciled to his sister, and treated E. so sharply that she retired to Jerusalem, where she died. Her latter days were spent in works of piety and charity. She enriched churches, rebuilt the walls of the Holy City, and founded many monasteries and hospitals. Through the influence of the famous Simeon Stylites, she was induced to renounce Eutychianism, and become an orthodox Catholic Christian. E. was a poetess of considerable merit. She wrote a poem in heroic verse on the victory of the troops of Theodosius over the Persians, 421 or 422; a paraphrase of eight books of Scripture; a paraphrase of Daniel and Zechariah, and a poem in three books on the history and martyrdom of Cyprian and Justina. The authorship of *Homero-Centones* also has (but without sufficient reason) been attributed to her. This is a work composed of verses taken from Homer, and so arranged as to appear a history of the fall of man and of his redemption by Christ. It has been often published.—EUDOCIA was the name of several other Byzantine princesses.

EUDOXIANS, n. ū-dōks'i-ānz: in chh. hist., followers of Eudoxius, who from A.D. 356 was bishop of Antioch, in Syria, and from 360 to his death in 370 bishop and patriarch of Constantinople. He was successively an Arian, a Semi-Arian and an Aëtian. Respecting the Trinity, he believed the will of the Son to be differently affected from that of the Father,

EUDOXUS—EUGENE.

EUDOXUS, *ū-dōks'üs*, of Cnidus: called by Cicero the prince of astronomers: lived about B.C. 366. He studied under Plato and afterward went to Egypt, where he resided 13 years, and had much intercourse with the Egyptian priesthood, from whom he is supposed to have derived his superior knowledge. His last years are said to have been spent on the summit of a high hill, that he might have the starry heavens ever before his eyes. There is little reason for believing that E. deserves great admiration for his attainments in astronomy. He probably introduced the sphere into Greece, and may have corrected the length of the year, upon Egyptian information, but he appears to have been but an indifferent observer of heavenly phenomena, and Delambre considers that he was ignorant of geometry. E.'s works are entirely lost, and our only reliable sources of information regarding him are the poem of Aratus and the commentary of Hipparchus.

EUDYTES, n. *ū-dī'tēs* [Gr. *eu*, good; *dūtēs*, a diver—from *duō*, I dive]: in *ornith.*, genus of *Spheniscidae*. *E. demersa* is the jackass penguin.

EUFAULA, *ū-faw'lā*: city of Barbour co., Ala.; on the w. bank of the Chattahoochee river; terminus of the Montgomery and E. and the Southwestern Georgia railroads; 50 m. w. of Columbus, 80 m. e.s.e. of Montgomery. The largest steamboats can ascend the river to E. all the year round. It contains 7 churches, 2 national banks (cap. \$159,000), and 1 private bank, public hall, fair ground, female college, school for colored children, 3 hotels, 2 weekly newspapers, several cotton warehouses, and carriage and furniture factories. The average sales of cotton are 30,000 bales annually. Pop. (1870) 3,185; (1880) 3,836; (1890) 4,394; (1900) 4,532.

EUGENATE: see EUGENOL.

EUGENE, *ū-jēn'* FRANÇOIS (le Prince François-Eugene de Savoie-Carignan), better known as Prince EUGENE: general and statesman: 1663, Oct. 18—1736, Apr. 21; b. Paris; son of Eugene Maurice, Count of Soissons, and of Olympia Mancini, niece of Cardinal Mazarin. He was intended for the priesthood; but the banishment of his mother to the Low Countries by order of Louis XIV., was so deeply resented by him, that he indignantly renounced his country, and entered the service of Emperor Leopold as a volunteer against the Turks. Subsequently, the French government made him most flattering offers, but he never returned to the service of his native country. He showed extraordinary military talent in the Turkish war, especially at the famous siege of Vienna, 1683, and soon rose to a high position in the army. In the Coalition war against Louis XIV., in Italy, he was active; and 1691 he was raised to the command of the imperial army in Piedmont. On his return to Vienna, he was placed at the head of the army of Hungary, and defeated the Turks, with immense slaughter, in the famous battle of Zenta, 1697, Sep. 11. The booty obtained was almost incredible,

EUGENESIS.

amounting to several millions sterling. In 1701 broke out the Spanish War of Succession. E. for two years commanded the army of Italy, but his forces were too small for any deeds of importance. In 1703, being appointed pres. of the council of war, he became thenceforth the prime mover of every undertaking. He first took command of the imperial army in Germany, and with Marlborough gained a brilliant victory at the battle of Blenheim, 1704, Aug. 13, when the two commanders defeated the French and Bavarian army. E. afterward saved Turin, and expelled the French from Italy in 1706. He shared, too, with Marlborough the glory of the fields of Oudenarde (1708) and Malplaquet (1709); but being crippled in his resources by the retirement of Holland and England from the contest, he was unable to withstand the enemy on the Rhine, and his defeat by Villars at Denain, 1712, July 24, was followed by other disasters, until the peace of Rastadt put an end to the war. In 1716, on the recommencement of the war against the Turks, E. defeated an army of 180,000 men at Peterwardein, took Temeswar, and in 1717, after a bloody battle, gained possession of Belgrade. After the peace of Passarowicz, concluded in the following year, he returned covered with glory to Vienna, where, during the succeeding years of peace, he labored with unwearied energy in the cabinet. When the question of the succession to the throne of Poland brought on a new war with France, E. appeared again on the Rhine; but being now advanced in years, and destitute of sufficient resources, he accomplished nothing of importance. After peace, he returned to Vienna, where he died. E. was small in stature, with thin face, and long nose; he was simple in dress and manner, and indulged profusely in snuff. An enthusiast in his profession, and a strict disciplinarian, he was also kind-hearted and sympathetic, and always carefully attended to the wants of his men. He introduced no new tactics in the art of war, and was deficient in the guidance and command of masses; but by his rapidity of perception and decision, and faculty for making the best of existing circumstances, which was his *forte*, he raised the *prestige* of the Austrian arms to an eminence unequalled before or since. He served successively under three emperors, of whom he was wont to say, that in Leopold I. he had a father, in Joseph I. a brother, and in Charles VI. a master. E.'s political writings, published by Sartori, are important for the light that they throw on the history and the manners of the time. Compare Dumont, *Histoire Militaire du Prince Eugene*; Ferrari, *De Rebus Gestis Eugenii* (Rome 1747); Campbell's *Military History of Prince Eugene and the Duke of Marlborough*; and the monographs of Kausler (1838), Arneth (1858), and Von Sybel (1861).

EUGENESIS, n. *ū-jěn'ē-sis* [Gr. *eu*, well; *genesis*, origin; source]: quality of breeding well or freely; production of young by the union of individuals of different species or stocks.

EUGENIA.

EUGENIA, *ü-jé-ní-á*: genus of plants of the nat. ord. *Myrtaceæ*, nearly allied to *Myrtus* (see MYRTLE), and differing only in having a 4-parted instead of a 5-cleft calyx, four instead of five petals, and a 1-2-celled berry, with one seed in each cell. The species are trees and shrubs, natives chiefly of tropical and sub-tropical countries. The dried fruit of *E. Pimento* and *E. acris* forms the spice well known as allspice, Jamaica pepper, or PIMENTO (q.v.). The seeds of *E. Tabasco* also are used as a condiment. Other species yield some of the finest fruits of tropical regions, remarkable for their delicious balsamic odors. Among these is the MALAY APPLE (*E. Maluccensis*), native of the Malayan archipelago and of the South Sea Islands, a low tree, with ovate-oblong smooth leathery leaves, and fruit in size and shape resembling a small apple, of a beautiful red color, and with a white juicy pulp. This fruit has an agreeable odor, like that of the rose, whence it is sometimes called Rose APPLE; a name which, on the same account, is often extended to the fruits of allied species, as *E. aquea*, and very often given to the JAMBOS or JAMROSADE (*E. Jambos* or *Jambosa vulgaris*), an E. Indian fruit, now cultivated in all tropical countries. This fruit is pear-shaped, about the size of a hen's egg, white or red. The tree is 20 or 30 ft. high, much branched, with leaves somewhat like those of the peach, and greenish-yellow flowers in terminal bunches. *E. caulinflora*, a Brazilian species, cultivated in most of the gardens of the diamond and gold districts of the south of Brazil, yields a very fine fruit of a black color, about the size of a greengage plum, called the JABUTICABA or JABOTICABUROS. Similar fruits are produced by other Brazilian species, particularly *E. dysenterica*, *E. inocarpa*, and *E. Braziliensis*. The BASTARD GUAVA (*E. pseudopsidium*) and the



Cayenne Cherry (*Eugenia Michelii*).

CAYENNE CHERRY (*E. cotonifolia* and *E. Michelii*) produce fruits which are held in considerable esteem in the W. Indies. One species only, the UGNI (*E. Ugni*), native of Chili, appears to be sufficiently hardy for the climate of

EUGENIACRINIDÆ—EUGENIUS.

southern temperate regions: it has been recently introduced into the south of England, and much extolled as a fruit shrub. Its flowers are very fragrant, and its fruit pleasant. It is much cultivated in Chili; and a refreshing beverage, with an agreeable balsamic odor, is made of the expressed juice mixed with water. The fruit is of the size of a black currant, somewhat flattened, and of a brownish-red color.—The bark of many species of E. is very rich in tannin. Some produce good timber.

EUGENIACRINIDÆ, n. *ū-jěn-i-ă-kri'ni-dē* [L. *eugenius*; *crinon*, a lily]: in paleon., family of *Crinoidea*. Range in time, from the Oolite to the Chalk. *Eugeniacrinus* is the type.

EUGENIC, a. *ū-jěn'ik*: obtained from or relating to cloves. **EUGENIC ACID**: see *EUGENOL*.

EUGENIE-MARIE DE GUZMAN, *ūh-zhā-nē'-mā-rē' dā góth-már'*: Empress of the French: b. Granada in Spain, 1826, May 5; second daughter of the Count of Montijo and of Marie Manuela Kirkpatrick; descendant, on the father's side, from an old and noble Spanish family, which, by marriages at various times, acquired the right to assume the names of Guzman, Fernandez, Cordova, La Cerdá, and Levia, and contracted alliances with the noble families of Téba, Banos, and Mora. By her mother—also born in Spain, and the daughter of Mr. Kirkpatrick, some time English consul at the Spanish seaport of Malaga—she is connected with an ancient Scottish family—the Kirkpatricks of Closeburn—which still exists, but no longer in possession of their original property. She was educated principally at Madrid, and spent a great portion of her youth in travelling with her mother, under the name of Countess de Téba. In 1851, she appeared at the *fêtes d'Elysée* in Paris, where her beauty and graceful demeanor attracted the notice and excited the admiration of Emperor Louis Napoleon, who married her 1853, Jan. 30, at Notre Dame. On that occasion an amnesty was granted to 4,312 political prisoners. In 1859, E. filled with ability the office of regent. During the Franco-German war in 1870, E. was again regent, but had to flee to England after the emperor became a captive. Her only son, the prince imperial, b. 1856, Mar. 16, completed his military education in England, and was killed 1879 while serving as a volunteer in the Zulu war, in s. Africa.

EUGENIN, n. *ū'jěn-in*: in chem., clove camphor, a crystalline substance deposited from water which has been distilled from cloves. Nitric acid turns it blood red.

EUGENIUS, *ū-jě'ni-us*, IV., Pope: began pontificate 1431; d. 1447; b. Venice. The great event in his career was the schism created in the church by the proceedings of the Council of Basel, which had been convoked by E.'s predecessor, Martin V., and showed strong tendency to ecclesiastical reform. E. was kept in perpetual trouble by this council, and at last, having been compelled to flee from Rome, opened a new council at Ferrara, 1438, and issued a

EUGENOL—EUGUBINE TABLES.

bull of excommunication against the bishops assembled at Basel, whom he pronounced to be ‘a satanic conclave, which was spreading the abomination of desolation into the bosom of the church.’ The result was, that the Council of Basel formally deposed him from his pontifical office 1439, and elected in his stead Amadeus VIII., Duke of Savoy, under the title of Felix V. The conduct of France and Germany seemed to warrant this bold step, for Charles VII. had introduced into the former country the decrees of the Council of Basel, with some modifications, through the Pragmatic Sanction (1438), and the same thing happened in Germany by means of the Deed of Acceptance (1439). At the Council of Ferrara, John Paleologus II., Emperor of Constantinople, and more than 20 Greek bishops, presented themselves, and a union between the two great divisions of Christendom—the Greek and Latin Church—was for a moment effected, 1439, July. Discord, however, broke out almost immediately, and the two have ever since remained separate. E.’s rival, Felix, did not obtain much recognition, and after the death of E. at Rome he had to give way in favor of Nicholas V. E.’s pontificate was stormy and unhappy, and in his old age he is said to have regretted that he ever left his monastery.—The name EUGENIUS was borne by three other popes.

EUGENOL, n. *ü'jēn-öl* [mod. L. *eugenia*: Eng. *alcohol*]: $C_{10}H_{12}O_2$, also called Eugenic-acid; contained in the volatile oil of *Caryophyllus aromaticus* (oil of cloves), and in oil of pimento.

EUGLEÑA, n. *ü-glē'nă* [Gr. *euglēnos*, bright-eyed; *eu*, well, bright; *glēnē*, the pupil of the eye, the eye-ball]: in bot., microscopic and animal-like plant. It is locomotive, with a red-eye speck, a tail-like process, and a single flagelliform filament. The species or forms are present in some pools to such an extent as to render the water green or red, and form a brilliant pellicle on the surface. The coloring matter is insoluble in water, but is soluble in alcohol, from which it crystallizes in octohedra. **EUGLE'NIA**, n. *-ni-ä*, in zool., name given by Dujardin to a family of infusoria, nearly the same as *Astasia* of Ehrenberg. They were supposed to belong to the order *Flagellata*.

EUGRATIOLEÆ, n. *ü-grät-ü-ö'lē-ë*: in bot., sub-tribe of scrophulariads, tribe *Gratiolæ*.

EUGUBINE TABLES, *ü'gū-bīn* [Lat. *Tabulæ Eugubinæ*]: seven bronze tablets, the inscriptions on which present a comprehensive and very remarkable memorial of the Umbrian language. They were discovered 1444 at Gubbio (anc. Iguvium or Eugubium), where they are still preserved. The characters on four of the tablets are Umbrian, on two Latin, and on one partly Latin and partly Umbrian. The language employed, however, is in all cases the same, and differs both from Etruscan and Latin, but resembles somewhat the older forms of the latter, and also the Oscan dialects, so far as we know them. The subjects of the inscriptions are directions concerning sacrificial usages and forms of prayer, and they seem to have been inscribed three or

EUHARMONIC—EULER.

four centuries before the Christian era. Philip Bonarota first published them in complete form in Dempster's *Etruria Regalis* (2 vols. Florence 1723–4). The first really judicious attempt at interpretation was that of Lanzi, in his *Saggio di Lingua Etrusca* (3 vols. Rome 1789), who points out the important fact that they related to sacrificial usages, etc. His views have been carried out by Ottfried Müller in *Die Etrusker*; Lepsius, *De Tabulis Eugubinis*, etc. The most accurate copy of the inscriptions is given by Lepsius in *Inscriptiones Umbriae et Oscæ* (Leip. 1841); the best and most complete work on the language and contents of the tablets is that of Aufrecht and Kirchhoff, *Die Umbrischen Sprach. Denkmäler* (1849–51).

EUHARMONIC, a. *ū-har-mōn'īk* [Gr. *eu*, well; good; *harmonikos*, harmonic]: in mus., producing perfect harmony or concord; used to distinguish concordant sounds from those produced by the tempered scale.

EUHEMERISM, n. *ū-hēm'ēr-īzm* [Gr. *Euēmēros*: L. *Euhēmērus*, a Greek writer, b.c. 316, who treated myths as dressed-up plain histories]: system of mythological interpretation which reduces the gods of old to the level of distinguished men, and considers the myths as founded on real histories (see MYTH). **EUHEM'ERIST**, n. *-ist*, one who believes in or maintains these views. **EU'HEMERIS'TIC**, a. *-is'tīk*, pertaining to.

EUKAMPTITE, n. *ū-kāmp'tīt* [Gr. *eukamptēs*, well bent or curved; *eu*, well; *kampto*, I bend, I curve]: in mineral., according to Dana, a hydrous variety of biotite.

EULENSPIEGEL, TYLL : see OWLGLASS.

EULER, *yō'lēr*, LEONARD : 1707, Apr. 15—1783, Sep. 7; b. Basel : one of the greatest of mathematicians. He received his first instructions in mathematical science from his father, pastor of the neighboring village of Riechen. At the Univ. of Basel, he studied under John Bernouilli, and was the friend of Daniel and Nicholas Bernouilli. At the age of 19, he was second in the contest for a prize offered by the Acad. of Paris for the best treatise on the masting of ships. His friends, the Bernouillis, had been called to St. Petersburg by Catharine I., when she founded the Acad., and they now induced E. to settle in that capital, 1730, as prof. of physics. Three years later, he exchanged his professorship for a place in the Academy. From that time, he continued to labor in mathematics with astonishing ardor. More than half the mathematical treatises in the 46 quarto vols. published by the St. Petersburg Acad. 1727 to 83 are by E., and at his death he left more than 200 treatises in ms., afterward published by the Academy. The Paris Acad. of Science awarded him the prize on ten several occasions, one of which was his treatise on Tides, 1740. In 1741, he accepted the invitation of Frederick the Great to Berlin. He returned to St. Petersburg 1766, where he was made director of the mathematical dept. of the Acad., and where he died. The last years of his life were spent in total blindness.

E. was amiable and religious, always cheerful and good

EULOGY—EUMENIDES.

humored; in society, he was distinguished for agreeable wit. It was doubtless his residence in St. Petersburg that led him to the application of mathematics to the building and management of ships, as embodied in his *Théorie de la Construction et de la Manœuvre des Vaisseaux* (Petersb. 1773). The great problems left by Newton to his successors were the objects of his unceasing research. On physical subjects, E. often adopted extremely untenable hypotheses. He occupied himself also with philosophy in the proper sense of the word. He undertook to prove the immateriality of the soul, and to defend revelation against free-thinkers. In his *Lettres à une Princesse d'Allemagne sur quelques Sujets de Physique et de Philosophie* (3 vols. Berl. 1768; new ed. Par. 1812; translated into English), he attacked Leibnitz's system of monads and of a pre-established harmony. But this was not the field in which he was best fitted to shine; his proper domain was the abstruser parts of pure mathematics. His most important works of this class are *Theory of Planetary Motion*, *Introduction to the Analysis of Infinites*, *Institutions of the Differential and of the Integral Calculus*, and *Dioptrics*; all, as well as *Opuscula Analytica*, in Latin. His *Introduction to Algebra* is well known.

EULOGY, n. *ū'lō-jī* [Gr. *eulōgiā*, good language, praise —from *eu*, well; *logos*, a discourse]: the praise of any one, written or spoken; encomium; praise. **EULOGIC**, a. *ū-lōj'īk*, or **EULOG'ICAL**, a. *-i-kūl*, containing praise. **EULOG'ICALLY**, ad. *-lī*. **EULOGISTIC**, a. *ū'lō-jīs'tīk*, or **EU'LOGIS'TICAL**, a. *-tī-kūl*, containing praise; commendatory. **EU'LOGIS'TICAL-LY**, ad. *-lī*. **EULOGIUM**, n. *ū-lōjī-ūm*, praise; commendation; panegyric; eulogy. **EULOGIZE**, v. *ū'lō-jīz*, to praise highly; to extol. **EU'LOGIZING**, imp. **EU'LOGIZED**, pp. *-jīzd*, praised. —**SYN.** of 'eulogy': panegyric; applause; culogium.

EULOPHIA, n. *ū-lōfī-a* [Gr. *eulophos*, well plumed; *eu*, well; *lophos*, the back of the neck, the crest of a helmet: named because the labellum bears elevated lines or ridges]. in bot., genus of orchids, tribe *Vandeæ*, family *Sarcanthidæ*.

EUMANITE, n. *ū'man-īt* [Gr. *eu*, very; *manos*, scanty, scarce]: in mineral., a variety of brookite found in minute crystals at Chesterfield, Mass., in an albite vein.

EUMENES, n. *ū'mēn-ēz* [Gr. *Eumenes* as a Greek proper name, borne by various kings; as adjective, *eumenēs*, well disposed, gracious; *eu*, well; *mēnos*, temper, disposition]: in entom., typical genus of the family *Eumenidæ*. The genus, which is extensive, consists of large and, as a rule, gaily colored insects, with a very long petiole and a pyriform abdomen. **EUMEN'IDÆ**, n. *-i-dē*, family of solitary wasps akin to the *Vespidae*, in which they are sometimes merged.

EUMENIDES, *ū-mēn'i-dēz* [Gr., literally, the well-minded or benign goddesses]: euphemistic name of certain fearful beings, whose true name of *Erinnys*, or *Erinnyes*, it was considered unlawful to utter. Their Latin name was *Furiæ* or *Diræ*. They are mentioned by the earliest poets,

EUMIMOSEÆ—EUNICE.

and they play a prominent part in the writings of the tragedians, where their sphere of action is much extended. In the earliest times, Homer and Hesiod represent them as avenging and punishing perjury and murder, and the violation of filial duty and of the rite of hospitality; they were regarded also as goddesses of Fate (like the Pareæ), and had a share in the grim Providence which led the doomed ones into the way of calamity. A part of their function was also to hinder man from acquiring too much knowledge of the future. In these poets, their number is sometimes undefined; sometimes they appear as one. The limitation to the number three, as well as their names Alecto, Megæra, and Tisiphone, is of a later period, a whole chorus of Erinnyses appearing in the writings of Æsehylus. According to Homer, they dwelt in Erebus, and with this the duration after death of the punishments which they inflict is connected. Hesiod calls them the daughters of Ge and Uranus. Æsehylus describes them as having the features of gorgons and harpies, their bodies covered with black, serpents twined in their hair, and blood dripping from their eyes. The later poets and sculptors represented them in the more pleasing form of winged virgins, attired in the garb of huntresses, bearing torches in their hands, and with a wreath of serpents round their heads. Gradually, they came to be considered goddesses of the infernal regions, who punished crimes after death, but seldom appeared on earth. In Athens, their worship, which like that of the other infernal deities, was conducted in silence, was held in great honor. The sacrifices offered to them were black sheep and libations of *nephalia*—i.e., honey mixed with water. The turtle-dove and the narcissus were sacred to them. They had a sanctuary in the vicinity of the Areopagus, and one at Colonus.

EUMIMOSEÆ, n. *ū-mī-mō'sē-ē*: in bot., typical tribe of the sub-order *Mimoseæ*.

EUMOLPUS, *ū-mōl'pūs* [Gr. ‘sweet singer’]: in the later mythology of Greece, son of Poseidon and Chione. He was brought up in Ethiopia, whence he went to Thrace, and afterward passed into Attica at the head of a body of Thracians, to assist the Eleusinians in their war against Erechtheus, King of Athens. E. and his sons are said to have been slain in battle. He is spoken of as the founder of the Eleusinian mysteries. A distinction is made by some of the ancient writers between this E. and a son of Musæus bearing the same name. The latter is represented as a scholar of Orpheus, and the instructor of Hercules; but E.’s history, like all mythological stories, is involved in great obscurity and confusion. The name of E. is one of the series of those old priestly singers who, by the institution of religious ceremonies, spread culture and morality among the rude inhabitants of Hellas. An illustrious Athenian family, the *Eumolpidæ*, derived their descent from E., and held the office of priests of Demeter in Eleusis.

EUNICE, n. *ū-nī'sē* [Gr. *Eunikē*, Eunice, Gr. female proper name; *eu*, well, good; *nikē*, conquest, victory]: in

EUNICIDÆ—EUOMPHALUS.

zool., typical genus of the family *Eunicidæ* or the tribe *Euniceæ*. *Eunice gigantea*, is a sea-centipede, sometimes as long as four ft., and consisting of above 400 rings. It is found in the ocean adjacent to the W. Indies.

EUNICIDÆ, n. *ū-nī'sī-dē*, or **EUNIC'EAE**, n. *-ē-ē*: in *zool.*, family or tribe of errant annelids with large branchial tufts, and from seven to nine toothed jaws.

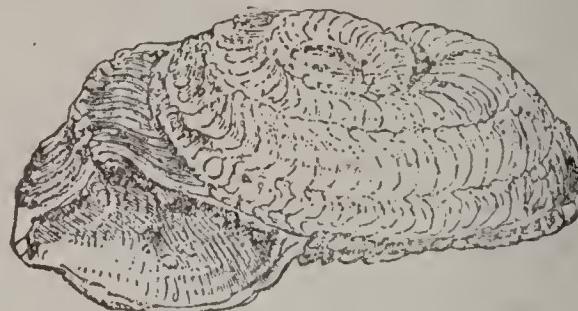
EUNOMIUS, *ū-nō'mī-ūs*: b. in the village of Dacora, Cappadocia; d. 394: founder of the Arian sect of Eunomians. He was first a lawyer, then a soldier, ultimately took holy orders, and in 360 was appointed bp. of Cyzicum. In the great controversy in the 4th c. regarding the Trinity, E. was conspicuous by his advocacy of the view that the Father alone was eternal and supreme; that the Son was generated of Him; and the Holy Spirit, again, of the Son. His doctrine of the Trinity is sometimes called the *Anomoian* ('dissimilar'), to distinguish it, on the one hand, from the *Homoiousian* ('similar'), held by the semi-Arians, and, on the other, from the *Homoousian* ('identical'), held by the Athanasian or Trinitarian party. It was thus the extreme of Arianism, now known as the Unitarian view. In defense of his peculiar views, E. is said to have shown superior ability, though his opponents accuse him of being verbose and inflated in his style. His life was much checkered. He was banished from one place to another, until at length he obtained permission to retire to his native village, where he died. His writings have entirely perished, with the exception of a fragment here and there preserved in the writings of his adversaries.

EUNUCH, n. *ū'nūk* [Gr. *eunouchos*, one who is castrated —from *eunē*, a bed; *ēchō*, I have or keep: L. *eunūchus*; It. *eunuco*; F. *eunuque*, a eunuch]: the barbarous practice of employing castrated males as guardians of the other sex, is an accompaniment of polygamy, therefore found chiefly in the East and in n. Africa. When it has appeared in countries where monogamy was the law, it was in consequence of the introduction of oriental luxury, as under the Roman emperors. The practice is of great antiquity, and seems to have originated in Libya, and from that to have spread to Egypt and the East. Syria and Asia Minor were the most notorious in this respect. In Greece, it never obtained prevalence; for though Greek women were kept in seclusion, polygamy itself never prevailed. The later Romans kept eunuchs, but they were mostly imported. In the Byzantine empire, on the contrary, castration and keeping of eunuchs, were very prevalent. This class were prominent in the court of the Eastern Empire, and the word E. came to be the title of an office similar to that of chamberlain. In modern times, the practice is confined mostly to Mohammedan countries, and the eunuchs are brought chiefly as slaves from the interior of Africa. **EU'NUCHATE**, v. *-āt*, to make a eunuch. **EU'NUCHATING**, imp. **EU'NUCHATED**, pp. **EU'NUCHISM**, n. *-īzm*, the state of a eunuch.

EUOMPHALUS, n. *ū-ōm'fā-lūs* [Gr. *eu*, well; *ōmphalōs*,

EUONYMUS—EUPATORIUM.

the navel, the boss of a shield]: large genus of fossil gas-teropodous shells, characterized by its depressed and discoidal shell, with angled or coronated whorls, five-sided mouth, and very large umbilicus. The operculum was shelly, round, and multi-spiral. The genus seems related to *Trochus*. It appears among the earliest tenants of the



Euomphalus Discors.

globe, and keeps its place till the Triassic period. No less than 80 species have been described. The figure represents one from the Wenlock limestone.

EUONYMUS, n. *ū-ōn'ī-mūs* [L. *Euonyme*; Gr. *Eunomia*, mother of the Furies, in allusion to the poisonous character of the berries]: spindle-tree; genus of trees, order *Celastraceæ*. About forty species are known. **EUONYM'EAE**, n. *-ō-nīm'ē-ē*, tribe of *Celastraceæ*, having capsular fruit. See SPINDLE TREE.

EUOSMITE, n. *ū-ōs'mīt* [Gr. *eu*, well; *osmē*, odor]: a fossil resin, so called from its strong, peculiar, and pleasant odor.

EUOTOMOUS, a. *ū-ōt'o-mūs* [Gr. *eu*, well; *temnō*, I cut]: in mineral., cleaving readily; having distinct cleavages.

EUPATORIA, *ū-pā-tō'rē-ā*, (formerly *Koslov*): thriving maritime town of Russia, govt. of Taurida; on a bay in the w. coast of the Crimea, 15 m. n.w. of Old Fort, 40 m. m.w. of Simferopol. The town stands on the border of a monotonous pastoral steppe, and is surrounded by low hills. Seen from the sea, it presents, with its occasional minarets and its houses roofed with red tiles, a picturesque appearance. The principal building is the Tartar mosque, built by Devlet-Ghiri Khan 1552, and reckoned the finest in the Crimea. E. exports corn, wool, and salt. Its harbor is shallow, sheltered only from the n. and n.e. winds. The people, mostly Crim-Tartars and Jews, are engaged chiefly as farmers and shepherds, and possess an immense number of oxen and sheep, and a large area of badly cultivated land. Pop. est. 13,416.

EUPATORIUM, *ū-pa-tō'rī-ūm*: genus of plants of the nat. ord. *Compositæ*, sub-order *Corymbiferæ*, having small flowers (heads of flowers) in corymbs, florets all tubular and hermaphrodite, club-shaped stigmas, imbricated bracts, a naked receptacle, and a hairy pappus. The species are numerous, and mostly American.—**THOROUGH-WORT** (*E. perfoliatum*), a species having the opposite leaves joined at

EUPATRID—EUPEN.

the base, is very common in low grounds in N. America, and is a popular medicine, much esteemed and used. It is often administered in intermittent fevers. It acts powerfully as a sudorific, and is very beneficial in catarrh and influenza. It is also emetic and purgative, and, in small doses, tonic. The whole plant is very bitter.—Other N. American species have similar properties, and the



Hemp Agrimony (*Eupatorium cannabinum*): *a*, a floret.

root of one, GRAVEL-ROOT (*E. purpureum*), is employed as a diuretic for relief of the disease from which it derives its name.—The AYAPANA (*E. Ayapana*), a half-shrubby species, native of the n. of Brazil, has high reputation in that country as a cure for snake-bites, and has been introduced into the E. Indies. It is a very powerful sudorific, and is also diuretic.—The famous Peruvian vulnerary, MATICO, has been referred, but uncertainly, to a shrubby species of this genus, *E. glutinosum*.—GUACO or HUACO, much valued in Peru as a cure for snake-bites, is supposed to belong to the allied genus *Mikania*. See AGRIMONY.

EUPATRID, n. *ū-păt'rĭd* [Gr. *eupatridēs*, of a good or noble father, of noble birth; *eu*, well, good; *patēr*, a father]: in Gr. *antiq.*, a member of the *Eupatridæ*, or aristocracy of Athens, in whom was vested the whole power of the state.
EUPAT'RIDÆ, n. *rĭ-dē*, plural of Eupatrid.

EUPEN, *oy'pēn*: flourishing manufacturing town of Rhenish Prussia in a beautiful valley on the Weeze, within 2 m. of the Belgian frontier, 9 m. s.s.w. of Aix-la-Chapelle. It is well built and open, including within its limits several gardens and meadows. There are four churches—three Rom. Cath., one Prot., also a convent, a high-school, and an orphan-house. E. has the most flourishing woolen manufactures of any town in Prussia, and has also dye-work, machine-making, and

EUPEPSY—EUPHORIA.

other manufactures. It owes the prosperity of its manufactures chiefly to a number of French refugees, who settled here after the peace of Lunéville. Pop. (1880) 15,033; (1890) 15,445.

EUPEPSY, n. *ū-pěp'si* [Gr. *eu*, well; *peptō*, I cook, I digest]: good digestion. **EUPEP'TIC**, a. *-tik*, pertaining to.

EUPHEMA, n. *ū-fē'ma* [Gr. *euphēmos*, auspicious; *eu*, well, good; *phēmē*, fame]: in *ornith.*, a genus of *Psittacidae*, sub-family *Pezoporinæ* (parrakeets, or parroquets). It contains some of the beautiful little grass parrakeets of Australia.

EUPHEMISM, n. *ū'fēm-izm* [Gr. *euphēmismos* for *euphēmīā*, the use of words of good omen—from *eu*, well; *phēmī*, I speak: F. *euphémisme*]: substitution of a delicate or indirect expression in order to avoid something offensive to good manners, or indecent; a mild name for something offensive. **EU'PHEMIS'TIC**, a. *-is'tik*, rendering less offensive or more delicate.

EUPHON, *ū'fon*, or **EUPHONON**, *ū'fo-nōn*: musical instrument invented by Chladni 1790; its tone, like that of the harmonica, is produced from the sounding body by the finger direct, without mechanism, and is regulated in quality and effect by the taste and feelings of the performer, who can produce tones from the most delicate pianissimo to fortissimo. In 1822, Chladni exhibited an improved E., of which a detailed description is given by himself in the Leipsic *Musik-zeitung* of that year, page 805.

EUPHONIA, n. *ū-fō'nī-a* [Gr. *euphōnia*, symphony; *eu*, well, good; *phōnē*, sound, voice]: in *mus.*, sweet sound; a consonant combination of sounds; in *ornith.*, a genus of *Fringillidæ*, sub-family *Tanagrinæ* (tanagers). *E. musica* is the organist tanager of the W. Indies, a small bird which sings well. The plumage of the male is mostly black and orange. **EUPHONIAD**, n. *ū-fō'nī-ād*, in *mus.*, instrument in which are combined the characteristic tones of the organ and other instruments. **EUPHONIUM**, n. *-ūm* [Gr. *euphōnos*, harmonious or pleasant in sound]: in *mus.*, brass bass instrument, properly belonging to a military band, but frequently introduced into the orchestra as a substitute for the third or bass trombone, to the tone of which the sound of the euphonium has not the slightest affinity.

EUPHONY, n. *ū'fō-nī* [Gr. *euphōnīā*, euphony—from *eu*, well; *phōnē*, a voice: F. *euphonie*]: an agreeable sound of words; a pronunciation of words or syllables pleasing to the ear. **EUPHON'IC**, a. *-fōn'īk*, or **EUPHON'ICAL**, a. *-ī-kāl*, agreeable in sound. **EUPHO'NIOUS**, a. *-fō'nī-ūs*, pleasing to the ear. **EUPHO'NIOUSLY**, ad. *-lī*. **EUPHONIZE**, v. *ū'fō-nīz*, to render agreeable in sound. **EU'PHONIZING**, imp. **EU'PHONIZED**, pp. *-nīzd*. **EUPHONICON**, n. *ū-fō'nī-kōn*, an improved pianoforte; also **EU'PHONON**, n. *fo-nōn*.

EUPHORIA, n. plu. *ū-fōr'bī-ū* [Gr. *euphōrbīōn*, a certain gum-resin—from *Euphorbos*, an anc. Greek physician]: genus of plants of many species, yielding an acrid milky juice, ord. *Euphorbiacēw*. **OIL OF EUPHORIA**, or **OIL OF**

EUPHORBIA.

CAPER SPURGE, an extremely acrid fixed oil, obtained by expression, or by the aid of alcohol or ether, from the seeds of the Caper Spurge (*Euphorbia Lathyris*), a plant common in many parts of Europe: see SPURGE. Oil of euphorbia has much resemblance to croton oil in its properties, though less powerful, and is sometimes used as a substitute for it, in doses of from three to ten drops. It is good for use only when recently extracted. EUPHORBIA'CEÆ, n.
-bi'-ā'cē-ē, very extensive nat. ord. of oxogenous plants, con-



Caper Spurge (*Euphorbia Lathyris*).

taining more than 2,500 known species—trees, shrubs, and herbaceous plants. They abound chiefly in warm countries, most of all in tropical America. The few species found in the colder parts of the world all are herbaceous. The common Box reaches a more northern limit than any other shrubby species. The Euphorbiaceæ usually abound in an acrid and poisonous milky juice; though there are species of which the juice is bland or becomes bland through the application of heat, so that their leaves may be used as food. The leaves in this order exhibit great diversities. The inflorescence also is various. Among those most remarkable for acridity of juice are the MANCHINEEL (q.v.) and *Exoccaria agallocha*, an E. Indian tree—formerly supposed to yield one of the kinds of aloes-wood—the smoke from the burning of which is extremely dangerous to the eyes. The juice also of many of the spurge is very acrid. Many Euphorbiaceæ are valued for their medicinal properties, different parts of the plant being in some instances used, and in some the resins and oils which they yield. Thus the juice of some of the spurge, the roots or bark of the roots of others, the bark of different species of *Croton* (Cascarilla Bark, Copalche Bark), etc., are used in medicine; and to plants of this order we are indebted for euphorbium, oil of euphorbia, castor oil, croton oil, etc. A few Euphorbiaceæ yield balsam;

EUPHRANOR—EUPHRASY.

products of exquisite fragrance (see CROTON); a few, though their juice is poisonous, yield a wholesome starch in considerable abundance (see MANIOC); a few are cultivated and used as pot-herbs, particularly species of *Plukenetia* in the E. Indies; a few yield wholesome and agreeable sub-acid fruits, as *Cicca disticha* and *C. racemosa* in the E. Indies; the seeds of some are eatable, as those of the Candle-nut (q.v.), of *Omphalea diandra*, a Jamaica tree, and of *Conceveiba Guianensis*, the latter being esteemed particularly delicious; the oil of the seeds also is in some cases used for food, like other bland oils (see CANDLE-NUT); but it is used more frequently for burning, as castor oil, candle-nut oil, the oil of *Elaeococca verrucosa* in Japan and Mauritius, and the concrete oil of *Stillingia sebifera*, used in China for making candles, and in medical preparations as a substitute for lard.—The dye-stuff called TURNSOLE (q.v.) is obtained from a plant of this order; and a bright red is imparted to silk by the roots of *Rottlera tinctoria*, native of Circassia, and by a red powder with which its seed-vessels are covered. The timber of some of the Euphorbiaceæ is valuable. African Teak (q.v.) belongs to this order. The red-colored wood of *Stylococcus trifoliatus* is used in Java for making masts. Some Euphorbiaceæ are often cultivated in gardens and hot-houses, more for their curious appearance than for their beauty; but the large deep crimson bracts of *Poinsettia pulcherrima*, native of Madagascar, make it a very attractive plant. EUPHORBIUM, n. -*bī-ūm*, extremely acrid gum resin, obtained from several species of *Euphorbia* or SPURGE (q.v.) as *E. officinarum* and *E. antiquorum*, in n. Africa, Arabia, and the E. Indies; and *E. Canariensis* in the Canary Islands. It is obtained by incisions in the branches, whence issues a corrosive milky juice, which dries in the sun, and becomes a yellowish-gray waxy gum resin. The persons who collect it are obliged to defend their mouths and nostrils by a cloth, as its particles produce incessant sneezing, violent inflammation of the nostrils, and a very painful burning sensation in the mouth. On account of its excessive acridity, it is now less used in medicine than formerly; though it is still occasionally mixed with Burgundy pitch or other substances to make rubifacient plasters for chronic affections of the joints; its alcoholic tincture is used as a caustic in carious ulcers, and its powder, mixed with much starch or flour, as an *errhine* in chronic affections of the eyes, ears, or brain. It was formerly administered as an emetic and drastic purgative, but is dangerously violent in its action.

EUPHRANOR, *ū-frā'nor*: abt. b.c. 365–325; b. Corinth: Greek painter and sculptor. He is said to have been a pupil of Ariston, was contemporary with Apelles and Praxiteles, painted in encaustic and worked in marble and bronze, and produced, among other works commended by Plutarch and Pliny, *The Twelve Gods*, *The Battle of Mantinea*, and the *Feigned Insanity of Ulysses* in painting, and statues of *Paris*, *Valor*, and *Greece*.

EUPHRASY, n. *ū'frā-sī*, or EUPRASIA [Gr. *euphrāsiā*,

EUPHRATES—EUPHUIISM.

delight]: the plant eye-bright, formerly supposed to be beneficial in diseases of the eyes; the *Euphrasii officinalis*, ord. *Serophulariaceæ*: see EYE-BRIGHT.

EUPHRATES, *ū-frā tīz* (in the oriental languages, *Frat*, *Phrat*, or *Forat*): largest river in w. Asia, forming with the Tigris, the most important river-system of that quarter of the world. It has its source in the heart of Armenia in two branches—the Kara Su and the Murad, of which the former rises 25 m. n.e. of the town of Erzerum, and flows s.w. to a point 10 m. n. of Keban' Ma'den, where it is met by the Murad, which rises on the s. slope of Alá Tagh, and flows w.s.w. to the point of confluence. From Keban' Ma'den, the E. flows in a general s. direction, with a tendency, however, to struggle westward toward the Mediterranean. In this part of its course, it breaks through the Taurus, and flows among the mountains for 45 m., emerging at Sumeiṣat, whence it continues navigable to the sea—a distance of 1,193 m.—and passing Bir, at which point it is 628 ft. above the level of the Mediterranean, and 100 m. distant from its nearest shore. After passing Samosta, it changes its direction, and flowing s., separates for a considerable distance Mesopotamia from Syria and the desert of Syrian Arabia. Curving s.e., it flows on, receiving scarcely any tributaries for about 700 m., until it is joined at Kurnah or Kornah by the waters of the Tigris. From Kurnah, the river, taking the name of the Shatt-el-Arab, continues in a s.e. direction, until, after being united by a canal with the Karun from the mountains of Persia, it empties by several arms, into the Persian gulf, 90 m. below Kurnah. The total length of the E. is 1,600 m.; area drained by all the waters which enter the Persian Gulf by the Shatt-el-Arab, 108,000 m. The average width of the Shatt-el-Arab is more than 600 ft.; it is navigable in mid-stream for vessels of 500 tons.—Various schemes have been proposed for an E. Valley railway, from the Mediterranean to the Persian Gulf, as an alternative route to India besides that of Suez.

The water of the E., though muddy, is not unwholesome. Its inundations, caused by the melting of the snows, are chiefly from the beginning of March, till the end of May; and in ancient times, when canals and embankments regulated these inundations, exercised the same beneficial effect on the country as those of the Nile on Egypt. See BABYLONIA.

EUPHROE, n. *ū'frō-ē* [etym. doubtful]: in naut., long slat of wood, perforated for the passage of the awning-cords which suspend the ridge of an awning. The euphroe (or uphroe) and its pendent cords form a crow-foot.

EUPHROSYNE, *ū-frōs'ī-nē* (i.e., the joyous one): one of the Graces (q.v.).

EUPHUIISM, n. *ū'fū-īzm* [Gr. *euphūēs*, growing or increasing well, graceful—from *eu*, well; *phūē*, growth]: an expression affectedly refined; high-flown diction, with attempt at excessive elegance. EU'PHUIST, n. -*ist*, one who

EUPHYLLITE—EUPODA.

uses such. EU'PHUIS'TIC, a. -*is'tik*, pertaining to. *Note.*—EUPHUISM properly took its origin from an extravagant and affectedly witty book by John Lyly (q.v.), in the reign of Elizabeth, which he called *Euphūēs*.

EUPHYLLITE, n. *ū-fil'līt* [Gr. *euphullos*, well leaved; *eu*, well; *phullon*, a leaf]: transparent or translucent mineral, like mica, but splitting less easily; found in Delaware.

EUPION, *ū-pi'-ōn* [Gr. *eu*, well; *pion*, fat, well-fed]: extremely mobile oil, obtained from the lighter portions of the liquid products of the destructive distillation of wood (wood-tar), coal (coal-tar), and animal matter, and in the distillation of rape-seed oil. It may be obtained in a sufficient state of purity by acting upon the crude tars and oils by concentrated sulphuric acid, or a mixture of sulphuric acid and nitre, which removes the majority of the other ingredients; and on the distillation of the portion which resisted the action of the acid, the first part which passes over is the eupion. When pure, it has the composition C₆H₆, and is therefore a hydro-carbon. It is the lightest liquid known, having the density of 655 (water = 1,000), and is thin, colorless, and tasteless, with pleasant aromatic odor. It boils at 116° F., and distils readily; and is very inflammable, burning with a white flame of considerable luminosity and penetrating power. It makes a greasy stain on paper, is insoluble in water, very slightly soluble in alcohol, but readily miscible with ethers and oils in general.

EUPLASTIC, a. *ū-plās'tik* [Gr. *euplastos*, that can be easily molded; *plassō*, I mold, I form]: in *phys.*, having the capacity of becoming organizablc in a high degree, as in false membranes, resulting from acute inflammation in a healthy person.

EUPLECTELLA, n. *ū-plēk-tēl'la* [mod. L., dimin. of Gr. *euplektoς*, well plaited, well twisted]: in *zool.*, Venus's Flower Basket, typical genus of *Euplectellidæ*, a family of siliceous sponges, section *Hexactinellidæ*.

EUPLEXOPTERA, n. *ū-plēks-ōp'tér-a* [Gr. *eu*, well; *plexis*, plaiting, weaving; *ptera*, wings: so called because the posterior wings, which are membranous, are so elaborately folded, both longitudinally and transversely, as not to be adapted for flight]: in *entom.*, name given by Westwood to an order of insects containing but one family, the *Forficulidæ* or earwigs. Leach called them Dermaptera.

EUPLOTES, n. *ū-plō'tēz* [Gr. *euplōtos*, favorable to sailing; *eu*, well; *plōtos*, floating]: in *zool.*, typical genus of the family *Euplota*, a family of infusoria, founded by Ehrenberg. The body is surrounded by a carapace; there are two distinct alimentary orifices, neither of which is terminal. The locomotive organs consist of cilia, hooks, claws or styles. There are many species.

EUPODA, *ū'po-da* [Gr. well-footed]: family of coleopterous insects of the tetramerous section of the order; named from the great size of the hinder thighs of many of the species. They feed on the stems and leaves of plants,

EUPOLIS—EURE.

some of them on aquatic plants, the roots of which afford food to their larvæ. The body is oblong; the antennæ filiform. Some of the E. are among the most splendid of tropical insects.

EUPOLIS, *ū'po-lis*: abt. B.C. 446–410; b. Athens: comic poet. He was author of numerous plays, some of which obtained the honors of triumph, and others satirized current political events and the manners and conduct of noted contemporaries, not even Alcibiades being spared. He was a rival of Aristophanes, and was thought by many critics to surpass him in purity and grace of diction. Several studies of his life, time, and works have been published, but only slight fragments of his comedies have been preserved.

EUPSAMMIA, n. *ū-sām'mi-a* [Gr. *eu*, abundant; *psammos*, sand]: in *paleon.*, family of actinozoa, tribe *Perforata*. **EUPSAM'MIDÆ**, n. *-dē*, in *zool.*, family of *Zoantharia Sclerodermata*, tribe *Perforata*; range in time from the Upper Silurian till now.

EUPYRCHROITE, n. *ū-pīr-kroīt* [Gr. *eu*, well; *pur*, fire; *chrōs*, skin, complexion]: in *mineral.*, variety of apatite.

EUPYRION, n. *ū-pīr'i-ōn* [Gr. *eu*, well, good; *pur*, fire]: contrivance for obtaining a light instantaneously, as a lucifer match, etc.

EURASIAN, n. *ū-rā'zī-ān* [contr. from *Europe* and *Asia*]: a cross-breed between a European and an Asiatic; denoting in India, chiefly the children by European fathers of Hindu mothers, and their descendants: ADJ. pertaining to both continents. **EURA'SIA**, n. *-zī ā*, sometimes used as a name for Europe and Asia conjoined.

EURE, *ūr*: river of the n.w. of France, tributary of the Seine. It rises in the dept. of Orne, flows first s.e. into the centre of the dept. of Eure-et-Loir, then n. and n.w. through the depts. of Eure-et-Loir and Eure, and joins the Seine on the left above Pont de l'Arche, after a course of about 100 m. Only the portion in the dept. of Eure is navigable.

EURE: department in the n.w. of France, immediately s. of the dept. of Seine Inférieure; 2,290 sq. m. Its surface is unusually level, as the highest eminences are not more than 300 ft. in height. The principal river is the Seine. The Eure, from which this dept. is named, and Rille, both affluents to the Seine, are the other important rivers. The climate is mild, moist, and foggy. Great part of the level country is covered with a loamy, alluvial soil upon a stratum of limestone; the remainder is of chalk, flint, and tufa. Along the Seine, the soil is in some parts sandy, stony, and barren, but the greater part is very fertile. The chief natural products are grain, hemp, flax, vegetables, and fruit, particularly apples and pears, from which large quantities of cider and perry are made. The breeding of cattle, horses, and sheep, is favored by extensive meadows and pasture-lands. Iron is found in considerable quantities. There are extensive iron and copper works and pin-

EURE-ET-LOIR—EURETE.

manufactories. Cotton goods, cloth, linen, paper, glass, and stoneware are manufactured. The dept. is divided into five arrondissements—Evreux, Louviers, Les Andelys, Bernay, and Pont-Audemer. The cap. is Evreux (q.v.). Pop. of dept. (1881) 364,291; (1901) 334,781.

EURE-ET-LOIR, *ür-ä-lwär*: department of France formed chiefly from the province of Orléannais: between lat. $47^{\circ} 57'$ — $48^{\circ} 55'$ n., and long. $0^{\circ} 47'$ — 2° e.; 2,260 sq. m. It is watered mainly by the Eure in the n. and the Loir in the s. This dept. lies on the water-shed between the Bay of Biscay and the English Channel. It is in general level, the e. and s. being occupied by high and extensive flats; while in the w. the scenery is finely varied by hill and valley. The soil is fertile and especially toward the e. and s. is admirably adapted for wheat. Hops grow spontaneously in some quarters. In the forests, the oak and birch are prevailing trees. The rivers, none navigable within the dept., furnish valuable water-power for numerous mills. Iron is the only mineral found and worked to any great extent; but the chief articles of trade are grain, flour, and wool. The dept. is divided into the four arrondissements of Chartres, Château-Dun, Dreux, and Nogent-le-Rotrou, with the town of Chartres for capital. Pop. of dept. (1881) 280,097; (1886) 283,719; (1901) 275,433.

EUREKA, n. *ü-rē'kă* [Gr. *eurekā*, I have found]: discovery made after long and difficult research—so called in allusion to the story of Archimedes, famous philosopher of Syracuse, who is said to have repeatedly uttered this word upon suddenly discovering a method of estimating the adulteration which King Hiero suspected that the goldsmith had made in his golden crown. The philosopher, whom the king had commissioned to test the crown, was stepping into his bath, and noticed that the water overflowed, being displaced in proportion to the bulk of the immersed object. Considering that gold is smaller than silver at equal weight, he inferred that the immersion of the crown would be a test of its alloy.

EUREKA, *ü-rē'ka*: town, cap. of E. co., Nev.; on the E. and Palisade railroad, connecting with the Central Pacific railroad 90 m. n. It is 35 m. w.n.w. of Hamilton, 65 m. e. of Austin, about midway between Salt Lake City and San Francisco. It has 20 mining districts more or less tributary to its prosperity; is within three m. of the famous Ruby Hill and Prospect Mountain mines, and has several lead and silver smelting works, a private bank, money order post-office, three churches, and several schools. Pop. (1880) 4,207; (1890) 1,609; (1900) precinct, 785.

EURETE, n. *ür'ē-tē* [Gr. *eurētos*, easy to tell—from *eu*, easy; *rheō*, I tell]: typical genus of the family *Euretidæ*, a family of hexactinellid sponges; range in time, from the Chalk till now.

EURIPIDES.

EURIPIDES, *ü-ri-p'i-dēz*: latest of the three great Greek tragedians: probably B.C. 480, Sep. 23—406; b. Salamis, on the very day, it is said, of the glorious victory of the Greeks over the Persians near that island. (The Arundel Marble, however, gives as the date of his birth B.C. 485, while Müller, following Eratosthenes, makes it B.C. 489). His education was very good. At first, he was trained to gymnastic exercises (in consequence of the prediction of an oracle that he should be crowned with ‘sacred garlands’); he turned his attention next to painting; then studied philosophy under Anaxagoras, and rhetoric under Prodicus, and formed a lasting friendship with Socrates. E.’s first play performed was the *Peliades* (B.C. 456). In B.C. 441, he gained the first prize for tragedy, and continued to write for the Athenian stage until B.C. 408, when he accepted an invitation to the court of Archelaus, King of Macedonia. Scandal has invented reasons unworthy of notice for E.’s leaving Athens. He is said to have been killed by dogs, set upon him by two brother-poets who envied his reputation. In E.’s time Greek tragedy had been brought to its highest point by Sophocles, who was 15 years older. E., however, was the second favorite author of his time; nay, on more than one occasion, his tragedies were preferred to those of Sophocles; but his liberal and even neologistic tendencies in regard to religion excited the hostility of that witty but scurrilous champion of Greek orthodox paganism, Aristophanes, who frequently ridiculed E. in cutting parodies. There can be no doubt that E. was systematically abused by the Athenian tory party, of whom Aristophanes was literary chief, and to whose unscrupulous opposition it was owing that he gained the prize only five times out of 75 competitions. But against the censure of Aristophanes, may be set the praise of two much greater men—Aristotle and John Milton. E.’s plays are reckoned by some to have amounted to 75, by others to 92. Only 18 have come down to us. These are—*Alcestis* (B.C. 438), *Medea* (B.C. 431), *Hippolytus* (B.C. 428), *Hecuba* (B.C. 424), *Heracleidae* (B.C. 421?), *Supplices* (B.C. 421?), *Ion* (date not ascertainable), *Hercules Furens* (date not ascertainable), *Andromache* (B.C. 420–417), *Troades* (B.C. 415), *Electra* (B.C. 415–413), *Helena* (B.C. 412), *Iphigeneia in Tauris* (date uncertain), *Orestes* (B.C. 408), *Phœnissæ* (probably same year), *Bacchæ* (written probably in Macedonia), *Iphigeneia in Aulis* (posthumously represented in Athens), and *Cyclops* (uncertain). *Rhesus*, attributed to E., is probably not genuine. Concerning E. and his tragedies, A. W. Schlegel remarks: ‘Of few authors can so much good and evil be predicated with equal truth. He was a man of infinite talent, skilled in the most varied intellectual arts; but though abounding in brilliant and amiable qualities, he wanted the sublime earnestness and artistic skill which we admire in Æschylus and Sophocles. He aspires only to please, no matter by what means. For this reason, he is so frequently unequal to himself; producing at times passages of exquisite beauty, and frequently sinking into positive vulgarity.’ The main object of E. was to excite emotion, and his works laid open a totally new world

EURIPUS—EUROPA.

(in literature), that of the heart, which beyond dispute, contributed much to their popularity. On the other hand, his inartistic and careless plots compelling him to a constant use of the *Deus ex machinâ* solution of difficulties, and occasionally even the subjects of his art themselves, leave ample room for criticism. Archelaus refused to allow his bones to be removed to Athens, and erected a splendid monument to him in Pella, with the inscription: ‘Never, O Euripides, will thy memory be forgotten!’ Still more honorable was the inscription on the cenotaph erected to him by the Athenians on the way to the Piræus: ‘All Greece is the monument of Euripides; Macedonian earth covers but his bones.’ Sophocles, who survived him, publicly lamented his loss; and the orator Lycurgus afterward erected a statue to him in the theatre at Athens. The *editio princeps* of E. appeared, it is thought, at Florence, toward the end of the 15th c. The best modern editions are: Beck (Leip. 1778–88), Matthiae (Leip. 1813–29), Kirchhoff (1855), and Nauck (1871). An English translation in verse by Potter, appeared, Oxford, 1814.

EURIPUS: see CHALCIS: EUBŒA.

EURITE, n. *ū'rīt* [F. *eurite*: Gr. *eurūtōs*, well or wide flowing]: a fine-grained white variety of felspathic granite; whitestone. **EURIT'IC**, a. *-īk*, pertaining to. **EURITIC-PORPHYRY**, in *petrology*, a porphyry of which eurite is the basis, or which consists mainly of eurite. Lyell regards it as plutonic rather than volcanic.

EUROCLYDON, n. *ū-rōk'lī-dōn* [Gr. *euros*, a s.e. wind; *klūdōn*, a wave]: tempestuous wind which prevails in the Mediterranean. In the account of the apostle Paul’s shipwreck, Acts xxvii. 14, the name E. is now thought to be properly *Euraquilo*: the meaning is in some doubt; but probably the bitterly cold tempestuous wind, now called *Bora*, which sweeps over the Adriatic, similar to a *north-easter*.

EUROMERICAN, n. *ūrō-mēr'ī-kan* [a contraction of European and American]: in *ethn.*, term introduced by Wilson (to whom we owe also ‘prehistoric’), to signify an American of European descent, as distinguished from the native inhabitants of America.

EUROPA, *ū-rō'pa*: in mythology, daughter of Agenor, King of Phœnicia, and Telephassa, and sister of Cadmus. Her extreme beauty enamored Jupiter, who, to engage her affections, assumed the shape of a bull and mingled with the herds of Agenor. E. caressed the animal, and in time had courage to mount his back, when he ran away with her, crossed the sea, and arriving in Crete, assumed his original shape and declared his love. Though under vows of perpetual celibacy, E. consented, and became mother of Minos, Sarpedon, and Rhadamanthus. Subsequently she married Asterius, King of Crete, who, finding himself without children by her, adopted those by Jupiter. It has been supposed by some that the original of this myth lived about B.C. 1552. From the mythical E. the continent of Europe was named.

EUROPE.

EUROPE, *ū'rūp*: smallest and most highly civilized of the three great divisions of the old continent. It is separated from America on the w. and n.w. by the Atlantic; and from Africa on the s. by the Mediterranean; and from Asia by the Archipelago, Sea of Marmora, Black Sea, Caucasian ridge, Caspian Sea, Ural river and mountains, and the Kara river. It is in the form of a huge peninsula, projecting from the n.w. of Asia. Its extent from Cape St. Vincent on the s.w. to the mouth of the Kara river on the n.e. is 3,400 m.; and from Cape Nordkun, the most northerly point of the Scandinavian mainland, to Cape Matapan, the southmost point of Greece, 2,400 m. The continent of E., irrespective of islands, lies within lat. $36^{\circ} 1'$ — $71^{\circ} 6'$ n., and long. $9^{\circ} 30'$ w.— $68^{\circ} 30'$ e.; area, estimated 3,367,000 sq. m., about a third of that of Africa, and a fourth of that of America. Pop. abt. 365,000,000; average, 108 to a sq. m. Its indented coast-line is more extensive in proportion to its size than any other great natural division of the globe, and is estimated not less than 50,000 m. This is caused by its great irregularity, and the number of deep inlets and gulf which penetrate its surface.

The body of the European continent divides itself naturally into two great portions—the great plain in the n.e., and the Highlands in the s.w.—the mountainous peninsula of Scandinavia lying apart from either, being in some sense exceptional. The plain occupies about two-thirds (2,500,000 sq. m.) of the entire extent of the continent. It reaches from the e. boundary of E., n. to the Arctic Ocean, s. to Mount Caucasus and the Black Sea, and w. over the whole extent of the continent; gradually, however, becoming narrower in its progress west. In shape, this plain resembles a triangle; its base rests on the e. boundary, and it may be said to reach its apex on the shores of Holland. It separates the two mountain systems of E.—the Scandinavian system (see SCANDINAVIA) on the n., and on the s. the system of s. Europe. The mass of the Alps, covering nearly 100,000 sq. m., forms the centre of the mountain system of s. and w. E., and stretches down on four sides toward France, Germany, Hungary, and Italy. The lowland plain, next Asia, lying e., is low, interspersed with woods and marshes, and cultivated land. See ALPS: APEN-NINES: BALKAN: CARPATHIAN MOUNTAINS: CEVENNES: PYRENEES: etc.

E. is surrounded by water on three sides. The White Sea comes in from the Arctic Ocean; the German Ocean and the Mediterranean from the Atlantic. The most important peninsula in the n. is Scandinavia, and in the s. are the Crimea, Turkey and Greece, Italy, and Spain. With the exception of Iceland, the islands cluster closely round the mainland, the chief being Great Britain and Ireland, Iceland, Seeland, Corsica, Sardinia, and Crete (Candia). The lakes of E. are small as compared with those of Africa or America. The Volga and the Danube are the largest rivers.

For details of the geography of E., see the titles of its

EUROPE.

several political divisions, and of its lakes, rivers, and mountains.

In respect of climate, far the greater portion of E. belongs to the n. section of the temperate zone, though parts of Norway, Sweden, and Russia lie within the Arctic Circle. The s. parts of Spain, Sicily, and Greece are abt. 12 degrees from the n. tropic. (See RAINFALL: TERRESTRIAL TEMPERATURE).

The European races belong in the main to the various branches of the great Aryan stock (see ARYANS: ETHNOLOGY), though in few European countries is there a pure race—the admixture of races being in some cases very great and close. But generally speaking, Celtic blood is found most largely in France (especially in Brittany where a Celtic tongue is still spoken), and a part of Great Britain and Ireland; Germanic people occupy Germany, Switzerland, Netherlands, part of Belgium, part of Austria, Denmark, Norway and Sweden, Iceland, and Great Britain. Slavonic races are found in Austria, Prussia, Turkey, and Russia (see SLAVONIANS). Romanic blood and language are prominent in Italy, France, Spain, and Portugal, and perhaps Roumania—but language is not always a true test of race. The Greeks belong to the same Greco-Italian branch as the Italians. Non-Aryan peoples are the Finns, Lapps, and Samoeds of the n. and n.e.; various Turanian tribes in the e. of Russia; the Hungarians and the Turks, and the Basques of the Pyrenees, also are non-Aryan; and a strong element of pre-Aryan blood is to be traced also in other parts of w. Europe, as Ireland and Britain. See titles of the various races and countries.

The table on the next page gives a comparative view of the states of Europe, their areas, and populations. In almost all except Russia and Turkey, the populations are given according to actual censuses 1878-81. For details as to the states composing the German empire, see GERMANY; for the constituent parts of the Austro-Hungarian monarchy, and of the joint kingdoms of Sweden and Norway, see the several titles. For the relation of Turkey to Bulgaria, Eastern Roumelia, Bosnia, and Herzegovina (the latter three being here included within its boundaries), see those titles.

Geology.—For the geology of E., see the different countries: also ALPS: PYRENEES: ETC.

Natural History.—The natural history of E. very much agrees with that of the corresponding latitudes of Asia. The natural history of the European countries on the Mediterranean Sea is very similar to that of Syria and of Asia Minor. The natural history of the more northern regions of E. resembles that of the great plains of Central Asia and Siberia. The most northern regions have the strictly arctic flora and fauna common in a great measure to all the arctic and subarctic regions; while the natural history of the most southern countries assumes a sub-tropical character. The European countries near the Mediterranean produce fewer of the shrubby and odoriferous *Labiate* than the Caucasus and adjoining regions, while the *Caryophyllaceæ* are more abundant. The extreme abundance of *Cistaceæ* is

EUROPE.

States.	Form of Government.	Extent in English sq. miles.	Population.	Number of inhabitants per English sq. mile.	Census Year.
Andorra.....	Republic, with a sovereign council.	175	34	(1901)	
Austria-Hungary.....	Limited monarchy, 2 chambers for each country	241,333	6,000	(1900)	
Belgium.....	Limited monarchy, two chambers.	11,373	45,405,267	(1900)	
Bosnia, Herzegovina, etc	Provinces occupied by Austria-Hungary.....	23,262	6,693,548	(1895)	
Bulgaria and E. Roumelia.....	Principality under Turkey.....	37,860	1,568,092	(1893)	
Denmark.....	Limited monarchy, two chambers	15,360	3,309,816	(1901)	
France.....	Republic, two chambers.....	207,054	2,464,770	(1901)	
Germany.....	Limited monarchy, two chambers.	208,830	38,961,945	(1901)	
Great Britain and Ireland.....	Limited monarchy, two chambers	120,979	56,367,178	(1900)	
Greece.....	Limited monarchy, one chamber	25,014	41,607,552	(1901)	
Italy.....	Limited monarchy, two chambers.....	110,550	2,433,806	(1896)	
Luxemburg.....	Grand-duchy, Netherlands	998	32,475,253	(1901)	
Monaco.....	Principality, one chamber.....	8	236,543	(1900)	
Montenegro.....	Limited monarchy (dependent), one chamber.	3,630	15,180	(1900)*	
Netherlands.....	Limited monarchy, two chambers	12,648	228,000	(1900)	
Portugal.....	Limited monarchy, two chambers	36,038	5,263,232	(1901)	
Romania.....	Limited monarchy, two chambers	50,720	5,428,659	(1900)	
Russia (Europe).....	Absolute monarchy.....	2,095,616	5,912,520	(1899)	
San Marino.....	Republic, sovereign council	38	106,264,136	(1897)	
Servia.....	Limited monarchy, two chambers	18,630	11,002	(1899)	
Spain.....	Limited monarchy, two chambers	194,783	2,493,770	(1900)	
Sweden and Norway:	{ Limited monarchy, two chambers for each country	172,876	134	(1900)	
Sweden.....	{ Limited monarchy, two chambers for each country	124,129	2,493,770	(1900)	
Norway.....	Republic, confederation, federal diet	15,976	2,239,880	(1900)	
Switzerland.....	Absolute sovereignty	65,752	3,315,443	(1900)*	
Turkey (Europe).....	Absolute sovereignty		6,086,300	92	

* Estimated.

EUROPE.

a peculiar feature of the flora of Spain and Portugal. The *Primulaceæ* are particularly plentiful in all the alpine regions of the s. of E., but this characteristic is in some measure shared by the Himalaya. In no other part of the world do umbelliferous and cruciferous plants form so large a proportion of the flora as in Europe.

The temperature of the w. and n. parts of E. being raised by the Gulf-stream and the winds from the great mass of dry and desert land in Africa above what is elsewhere found in similar latitudes, the flora and fauna exhibit a corresponding character, affected, however, by the great amount of moisture from the Atlantic Ocean; also to a still greater degree by the comparative uniformity of temperature which the proximity of the ocean produces. The effect of the last-mentioned causes is so great, that the northern limit of some plants is sooner reached on the shores of the Atlantic than in the more central parts of E., where the winters are much colder, and the average temperature of the year is lower. Of this the vine and maize are notable examples. Plants which require a mild winter will not grow in the n.—scarcely even in the centre of E.—but they advance along the w. coast under the influence of the maritime climate. Thus the myrtle—though not indigenous—grows even in the s. of England. Among plants, the date palm, and among animals a species of ape, are found in the s. of E. (the ape only on the Rock of Gibraltar); while some strictly Africian birds are frequent visitants, and many birds—as the cuckoo, swallow, etc.—are common to E. and Africa, inhabitants in summer even of far northern regions, and returning in winter to the warm south.

Of the plants now most commonly associated in our thoughts with the s. countries of E., may have probably been introduced from Africa, or the East. This seems to have been the case even with the myrtle, and certainly has been with the vine, the olive, the orange, lemon, etc., the fig, the peach, the almond, the apricot, etc. Some of the most extensively cultivated fruits are certainly indigenous to E., as the apple, pear, plum, and cherry, although even of these the first improved varieties may have been introduced from the earlier seats of civilization in the East. Among the wild animals of E. at the present day, the aurochs (bison) is still reckoned; and the ox existed wild at no very remote period. The reindeer inhabits the extreme n. of E.; the elk, the stag, the fallow-deer, and the roebuck, are found in more southern regions; the ibex or bouquetin exists on the high central mountains; two species of antelope—the chamois of the Alps, and the saiga of the Russian plains—connect the European fauna with the Asiatic and African. Of carnivorous animals, the most noticeable are the bear, the wolf, the fox, and lynx.

The abundance of lakes and streams in the n. parts of E. is accompanied with a corresponding abundance of water-fowl (*Anatidæ*) and of fish. Of the latter, the *Salmonidæ* are most valuable, and the *Cyprinidæ* next. The European seas afford valuable fisheries, particularly of herring and of

EUROPEAN—EURYNOTUS.

cod in the n., and of tunny, anchovy, etc., in the Mediterranean.

The common hive bee and the Ligurian bee may be regarded as probably natives of Europe. The silk-worm was introduced from the East. Another valuable insect, the cochineal insect, was introduced from America; but the *Cantharis*, or blistering fly, is truly indigenous to the s. of Europe.

EUROPEAN, n. *ū'rō-pē'ān* [Gr. *eurus*, broad, and the root *op*, to see: comp. Gael. *Eu-ropach*, unravelled, unknown]: a native of Europe: ADJ. pertaining to. **EUROPEANIZE**, v. to naturalize in Europe; to adapt or accommodate to European manners, character, or usages.

EURYALE, n. *ūr-i'a-lē* [L. *Euryale*, one of the Gorgons, from the thorny, menacing habit of the plant]: in zool., genus of *Ophiuroidea*; typical of the family *Euryalidae*. The arms are bifurcate. **EURYALIDÆ**, n. *ūr-i-äl'i-de* [mod. L. *euryale*]: in zool., Gorgon's head; family of *Ophiuroidea*. They have ten genital fissures, and branched arms and cirri like the dishevelled hair of the Gorgon; found in tropical seas.

EURYALE, *ū-rī'a-lē*: genus of plants of the nat. ord. *Nymphaeaceæ*, or Water-lilies, closely allied to **VICTORIA** (q.v.), though of very different appearance. *E. ferox* is a water-lily with small red or violet-colored flowers, leaves about 12 inches in diameter, the leaf-stalks and calyces covered with stiff prickles; native of India and China. The fruit is round, soft, pulpy, and of the size of a small orange, composed of a number of carpels, and containing round, black seeds as large as peas which are full of a nutricious, agreeable farina, and are eaten roasted. The root-stock contains starch, which may be separated and used for food; and the root itself is eaten. The plant is said to have been in cultivation in China for more than 3,000 years.

EURYDICE, n. *ū-rid'i-sē* [Gr.]: in *Gr. myth.*, the wife of Orpheus (q.v.); also the wife of Amyntas, King of Macedonia, and mother of Philip, the father of Alexander the Great.

EURLAIMINÆ, n. *ūr-i-lā-mī'nē* [Gr. *eurus*, broad, large; *laimos*, throat]: broad-bills; sub-family of *Coracidae* (rollers). They have short, very broad bills, rather short wings, and strong feet, the outer toe connected for half its length to the middle one, the hinder toe long, the inner one the shortest of any. They inhabit the E. Indies and adjacent islands, suspending their nests, composed of small twigs, from the branches of trees overhanging water; type, *Eurylaimus*.

EURYNOME, n. *ū-rī'n'o-mē* [Gr.]: in *Gr. myth.*, one of the Oceanides, who, together with Ophion, ruled over the world before Saturn and Rhea took possession of it.

EURYNOTUS, n. *ū'rī-nō'tūs* [Gr. *eurus*, broad, ample; *notos*, the back]: in geol., a genus of lepidoid fishes occurring in the carboniferous formation, having a high bream-like back. **EURYPTERUS**, n. *ū-rip'ter-ūs*, or **EURYPTERIDÆ**

EURYTHMY—EUSEBIUS.

n. plu. -*tér'i-dē* [Gr. *ptérōn*, a wing or fin]: in *geol.*, a genus and family of extinct crustaceans, allied to the king-crab, so termed in allusion to their broad, oar-like swimming feet. EURYPTERITE, n. -*tér-it*, any one of the eurypterus family, or any undetermined portion or specimen.

EURYTHMY, n. *ū'rīth-mī* [Gr. *eurūth'miā*, complete harmony—from *eu*, well; *ruthmos*, rhyme, measure]: in *arch.*, the exact proportion between all parts of a building.

EUSEBIAN, a. *ū-sē'bī-an* [named after two bishops, *Eusebius Pamphili*, bp. of Cæsarea, often called the Father of Church History, and the bp. of Nicomedia, afterward of Constantinople. Both were intimate with Constantine the Great]: relating to either of the two Eusebiuses. EUSEBIANS, a semi-Arian sect, followers of the two Eusebiuses. They held that there was a subordination among the persons of the Godhead, and are hence by some technically called Subordinationists. They opposed Athanasius and supported Arius at the Council of Tyre, 335, and subsequently.

EUSEBIUS, *ū-sē'bī-ūs*, of Cæsarea, or EUSEBIUS PAMPHILI: father of ecclesiastical history: abt. 264—abt. 340; b. in Palestine: He took the surname of Pamphili from his friend Pamphilus, Bp. of Cæsarea, whom he faithfully attended for the two years (307–309) of his imprisonment during the persecution of Diocletian. He then went to Tyre, and afterward to Egypt, where he himself was thrown into prison on account of his religion. In 315, he succeeded Agapius as bp. of Cæsarea, and was prominent at the Council of Nice 327. E. was the head of the so-called semi-Arian, rather the moderate party in the Council of Nice. That party were averse to discussing the philosophy of the Trinity, and would have preferred the simplicity of Scripture language in speaking about the Godhead to the metaphysical distinctions of either side. They regarded Trinitarianism, on the one hand, as logically indefensible, but, on the other, they recognized the fact, that Scripture in many passages speaks of the Son in terms not compatible with the views of Arius; therefore they wished each man to have the utmost freedom in his interpretation of Scripture on this point. E. thought that the great thing was to lay to heart the truth, that ‘God so loved the world that he gave his only begotten Son, that whosoever believeth on him should not perish, but have everlasting life.’ The promise is to him that *believeth on the Son of God*, not, he argues, to him that *knows how the Son is generated from the Father*. He was very reluctant to accept the term *homoousios* (of the same substance), devised by Athanasius to describe the equality of the Son with the Father, and retained the kindest feelings toward Arius after the views of the latter were condemned. His moderation and other excellent qualities procured him the favor of Constantine, who declared he was fit to be the bishop of almost the whole world. E. has the reputation of being after Origen the most learned Father of the church. His chief works are—1. The *Chronicon*, a history of the world down to the celebration

EUSEBIUS.

of Constantine's *Vicennialia* at Nicomedeia and Rome, 327 and 328. It is valuable as containing extracts from such writers as Berosus, Sanchoniathon, Polyhistor, Cephalion, and Manetho. It was published in a complete state first by Mai and Zohrab, Milan 1818, from an Armenian ms. version discovered at Constantinople. 2. The *Præparatio Evangelica*, 15 books, a collection of such statements in old heathen authors as were fitted to make the mind regard the evidences of Christianity in a favorable light: it was translated into Latin, and appeared at Treviso 1480. The Greek text was published first at Paris 1544. 3. *Demonstratio Evangelica*, 20 books, intended to convince the Jews of the truth of Christianity from the evidence of their own Scriptures: a Latin version of this was printed as early as 1498; the Greek original did not appear till 1544, when it was published with the *Præparatio*, at Paris, by R. Stephens. 4. The *Ecclesiastical History*, 10 books: this relates the principal occurrences in the Christian Church till 324, and contains the results of E.'s studies in numerous libraries, and even in the imperial archives, Emperor Constantine having ordered, at E.'s request, an examination of all documents relative to the history of martyrs. One drawback of the work is, that E., on principle, withholds all account of the wickedness and dissensions of Christians, inasmuch as he did not consider such stories for the edification of the church. A Latin translation by Rufinus was published at Rome 1474; the Greek text at Paris 1549, and Geneva 1612. Among more recent editions are those of Heinichen (Leip. 1827) and Burton (Oxford 1838). The *Ecclesiastical History* has been translated into English, German, French, etc. Besides the foregoing works, may be mentioned the *De Martyribus Palestinæ*, a book against Hierocles; another against Marcellus; and a *Life of Constantine*. The first edition of all E.'s works appeared at Basel 1542.

EUSEBIUS, of Emisa: b. at Edessa, d. at Antioch 360. He studied at Alexandria, and was pupil of Eusebius Pamphili, and friend of Eusebius of Nicomedia. Averse to all theological controversies, he declined the bishopric of Alexandria, vacant by the deposition of Athanasius. He was afterward, however, bp. of Emisa, but during his ordination, a Christian mob, accusing him of 'mathematics' and magic, created a tumult, and compelled him to flee for his life. Subsequently, he returned to Emisa, where he was 'tolerated,' in spite of his dangerous knowledge. Emperor Constantius was much attached to E., and used to take him on his military expeditions. E. was accused of Sabellianism (q.v.), and Jerome calls him 'the ringleader of the Arian party.' Jerome, however, was rash in his epithets, and it is more probable that he belonged to the party of his namesake of Cæsarea, the Semi-Arians, or peace-party, who wished the doctrine of the Godhead expressed in the language of Scripture, and not of human theology. The homilies extant under his name have been published by Augusti (Elberf. 1829). The genuine ones show great eloquence.

EUSEBIUS—EUSTACHIUS.

EUSEBIUS, of Nicomedia, Patriarch of Constantinople: b. toward the end of the 3d c., d. 342. First he was tutor to Emperor Julian, to whom he was related by the mother's side; then bp. of Beryta (Beyrouth), in Syria, and afterward of Nicomedia. In order to secure his position, he appeared as the defender of Arius at the Council of Nice, and afterward placed himself at the head of the Arian party. Under Emperor Constantine, whom he baptized 337, he became patriarch of Constantinople. In the year before his death he held an assembly of the church for the establishment of Arianism at Antioch. It is not easy to perceive his real character. We have no ecclesiastical works by Arian writers, our only sources of information as regards the character and opinions of that party being their enemies—the orthodox party; yet, making the ordinary allowance for partisanship, there seems reason for concluding that E. was cunning and double-tongued when occasion required, and imperious and violent when he had power in his hands. Athanasius considered him not the disciple, but rather the teacher of Arius. From him the Arians are sometimes styled Eusebians.

EUSKARIAN: term now often used for the Basque race (see BASQUE PROVINCES), especially in connection with the now prevalent theory, that peoples of this stock preceded the Aryans in w. Europe, and that even in England the Celts mingled with their Basque predecessors. Many ethnologists hold that in some parts of England, as s. Wales, the blood of the people is still mainly Euskarian.

EUSTACHIAN, a. *ū-stā'kī-ān* [after *Eustāchiūs*, a celebrated Italian anatomist, A.D. 1574]: in *anat.*, applied to a tube or canal extending from behind the soft palate to the middle ear, to which it conveys the air (see EAR). EUSTACHIAN VALVE, a fold of the lining membrane of the heart: see FÆTUS.

EUSTACHIUS, *ūs-tā'kī-ūs*, BARTOLOMMEO: Italian anatomist; b. in the early part of the 16th c., d. 1574. We learn that in 1562 he was prof. of medicine in the Collegio della Sapienza at Rome. His name is indelibly associated with anatomical science, through his discoveries of the tube in the auditory apparatus, and the valvular structure in the heart, which have been named from him. He was the first to give an accurate description of the thoracic duct, and probably the first to notice and describe the stapes (one of the chain of small bones crossing the tympanic cavity of the ear), a discovery which, however, Fallopius assigns to Ingrassias. He likewise contributed materially to the diffusion of more accurate knowledge regarding the development and evolution of the teeth, and the structure of the kidney. These discoveries are recorded in his *Opuscula Anatomica*, Venice 1563. He was the first anatomical writer who illustrated his works with good engravings on copper. The *Tabulae Anatomicæ* which he was probably unable to publish in consequence of the poverty of which he complains in the introduction referred to, did not appear until 1714, when they were edited, with

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explanatory remarks, by Lancisi. Their value is evidenced by the fact, that Albinus published a new edition, with an excellent Latin commentary, Leyden, 1743; that Bonn published a Dutch edition, Amsterdam 1798; and that a German edition appeared 1800. Lauth, in his *History of Anatomical Discovery*, remarks that if the *Tabulae* had appeared in E.'s lifetime, anatomy would have attained its advancement in the 18th c., nearly 200 years earlier. E., Vesalius, and Fallopius may be regarded as the three founders of modern anatomy.

EUSTATHIAN, a. *ū-stā'thī-an*: in *chh. hist.*, pertaining or relating to any of the bishops called Eustathius: N. a name given by the Arians to the Trinitarians who followed Eustace, Bishop of Antioch, about the date of the Nicene Council, 325; also the followers of Eustathius, Bp. of Sebaste, in Armenia, or another Eustathius, of whom nothing definite is known. The former was a semi-Arian, of strong puritanic and ascetic views, who went the length of prohibiting marriage. He was deposed by the Council of Melitena, 357, and that of Neo-Cæsarca 358. His followers were condemned by that of Nicopolis, 372.

EUSTATHIUS, *ū-stā'thī-ūs*: Greek commentator on Homer and the geographer Dionysius; b. Constantinople, d. 1198. He was first a monk, then a deacon and teacher of rhetoric in his native city, and, 1155, was appointed abp. of Thessalonica, where he died. E. was profoundly versed in the ancient classic authors, and a man of prodigious acquirements, as is proved by his commentaries. The number of authors whom he quotes is almost incredible, and the value of his quotations is heightened by the consideration, that most of the works from which he extracts are no longer extant. His most important work is his *Commentary on the Iliad and Odyssey of Homer*. The first ed. appeared at Rome 1542–50; the last at Leip. 1825–29. The work is open to objection on the score of method, and is diffuse and digressive, but it is nevertheless a vast mine of knowledge for students of Homer. Of similar character is E.'s *Commentary on Dionysius*, printed first by Stephens (Paris 1547), and, lastly, in Bernhardy's edition of Dionysius (Leip. 1828). Of his commentary on the hymns of Pindar, only the *Proœmium* has come down to us. It was published first by Tafel 1832, with E.'s theological treatises and letters.

EUSTATHIUS, SAINT, Bishop of Berrhœa, Syria, Patriarch of Antioch: b. Side, Pamphylia. He opposed the Arians with extreme vigor in the Council of Nieæa, and was rewarded with the patriarchate of Antioch 325. Five years later the Arians, in a synod at Antioch, secured his deposition on charges of Sabellianism and unfaithfulness to his vows of celibacy; but the inhabitants arose in his defense, and by so doing provoked the emperor into banishing E. to Thrace. A work against Origen, and an address to the emperor, delivered in the Council of Nicea, are his only extant writings.

EUSTATIUS, *ū-stā'shē-ūs*, ST: one of the Dutch W.

EUSTIS—EUTERPE.

India Islands, near the n.e. bend of the great arch of the Antilles, about 12 m. n.w. of St. Christopher; lat. $17^{\circ} 31'$ n., and long. $63^{\circ} 5'$ w.; 8 sq. m. St. E. is a pyramidal rock of volcanic formation, showing two extinct craters, and still subject to earthquakes. Hurricanes also of intense severity occur, particularly in August and September. Along its entire circuit of 29 m., St. E. has only one landing-place which, besides being difficult of access, is strongly fortified. The whole mountain is fertile, producing in abundance not merely commercial crops, such as sugar, cotton, and tobacco, but also provisions of various kinds, such as maize, hogs, goats, and poultry. Pop. about 2,000.

EUSTIS, JAMES BIDDLE: an American diplomatist; 1834, Aug. 27—1899, Sept. 9; was admitted to the bar, 1856, and practiced in New Orleans, La.; was judge-advocate on the staffs of the Confederate Gens. Magruder and J. E. Johnston, 1861-5; elected U. S. senator, 1876, to fill a vacancy; Prof. of Civil Law in the University of Louisiana, 1879-84, then re-elected senator; and was U. S. minister to France, 1893-7. In the latter year he resumed practice in New York city. He translated Guizot's *History of Civilization*.

EUSTYLE, n. *ū'stīl* [Gr. *eustulos*, with goodly pillars, with pillars at the best distances; *eu*, well, good; *stulos*, a pillar, a column]: in arch., that style of intercolumniation in which the space between the columns was two and a quarter times their diameter. So called from this being considered the most beautiful style.

EUTASSA, n. *ū-tăs'sa* [Gr. *eu*, well; *tassō*, I arrange]: in bot., *Eutassa excelsa*, better known as *Araucaria excelsa*, the huge Norfolk Island pine.

EU'TAW SPRINGS, BATTLE OF: 1781, Sep. 8; near the Santee river, in S. C., 60 m. n.w. of Charleston; between 2,000 Americans under Gen. Greene, and 2,300 British troops under Col. Stuart. A reconnoitering detachment of British cavalry was first attacked and put to flight 4 miles from E. S. Gen. Greene then marched upon a body of infantry one mile from the British camp; drove them in and captured the camp; and while the Americans were plundering it, the British troops suddenly reformed and renewed the engagement, when Greene withdrew the Americans out of range, with a view of attacking the British on their retreat. Stuart, however, retreated toward Charleston at night, leaving Greene to occupy the field the next day. British loss, killed, wounded, and prisoners, 633; American loss, killed, wounded, and missing, 535.

EUTERPE, n. *ū-ter'pē* [Gr. *eu*, well; *terpein*, to delight]: in anc. myth., one of the nine Muses, daughter of Zeus and Mnemosyne. She was the Muse of lyric poetry, presided over wind instruments, and music generally, and is represented in ancient art with a flute in her hand: see MUSES. EUTER'PEAN, a. *-pē-ān*, pertaining to music.

EUTERPE, *ū-ter'pē*: genus of palms, having male and

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female flowers intermingled on the same spadix, the spadices springing from beneath the leaves; the spathe entire, membranaceous, and deciduous. They are very elegant palms; with lofty, slender, smooth, faintly ringed stems; and pinnate leaves, forming a graceful, feathery plume; the bases of the leaf-stalks sheathing far down the stem, and so forming a thick column several ft. in length at its summit. To this genus the cabbage palm of the W. Indies, and the Assai palm of the banks of the Amazon, are often referred. See ARECA: ASSAI.

EUTHANASIA, n. *ū-thān-ă'zhī-ă*, or **EUTHAN'ASY**, n. -ă-si [Gr. *euthanasiū*, an easy death—from *eu*, well; *thānatos*, death]: an easy, happy death.

EUTROPHIC, n. *ū-trōf'ik*: in *path.*, agent which acts upon the nutritive system, without occasioning manifest increase of any of the secretions as a necessary consequence.

EUTROPHY, n. *ū'tro-fī* [Gr. *eu*, well, good; *trepħō*, I nourish]: in *path.*, a healthy state of the nutritive organs; healthy nutrition.

EUTROPIUS, *ū-trō'pi-ūs*: Latin historian, concerning whom we know only that he was sec. to Emperor Constantine, fought against the Persians under Julian, and was still living in the reign of Valens. His *Breviarum Historiæ Romanæ*, a short narrative of Roman history from the foundation of the city to the time of Emperor Valens, is written in an extremely simple and pure style, and appears to have been intended originally for the use of schools. It became very popular as the taste for original investigation declined, in that dark period between the death of the old world and the birth of the new; and is either copied or followed by the early monkish annalists. An ed. with enlargements, however, was published by Paul, son of Warnefrid ud Theodolinda, generally known as Paulus Diaconus. Others continued it down to 813. The History existed in three distinct forms at the revival of letters: there was first the genuine work of E. in ten books; second, the expanded editions of Paul; and third, a very complete, but largely interpolated copy in the *Historia Miscella*. The *editio princeps*, Rome 1471, was from the impure text of Paul. The best editions in modern times are those of Tzschucke (Leip. 1796, improved 1804), and of Grosse (Halle 1813; Leip. 1825).

EU'TYCHES: Byzantine ecclesiastic of the 5th c.; zealous but unskilful representative of the dogmatic opinions of Cyril of Alexandria. In opposing the doctrines of Nestorius, he fell into the opposite extreme, and taught that after the union of the two natures in Jesus Christ, the human nature was absorbed in the divine; an opinion which spread extensively through the Alexandrian Church. E. was in consequence summoned before a synod at Constantinople 448, and deposed by Flavianus, patriarch of that city; but his cause was warmly espoused by the eunuch Chrysaphius, chief minister of Emperor Theodosius II., and Dioscurus, Bp. of Alexandria—both opposed to Flavianus. Chrysaphius induced the emperor to call a general council at

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Ephesus in the following year, under the presidency of Dioscurus. Measures were taken beforehand to secure a triumph over the anti-Eutychians. Soldiers were admitted to the deliberations of the council, to overawe the party of Flavianus; while a crowd of fierce Egyptian monks, devotedly attached to whatever was popular in Alexandria, or had been countenanced by their old pupil Cyril, drowned by their fanatical outcries the voices of those who ventured to speak against Eutyches. See EPHESUS, COUNCILS OF. The result was that the judgment of the previous council was reversed; Flavianus and his adherents were deposed, and the doctrine of E. affirmed orthodox, and in accordance with the Nicene creed. His triumph, however, lasted only two years; in 451, Eutychianism was pronounced heresy at the Council of Chalcedon, attended by 650 bishops; and in opposition to his views, it was declared that in Christ the two natures were united without confusion or conversion of substance. Nothing further is known concerning E., except that Leo wrote to Emperor Marcian to banish him from the capital. The sect of Eutychians, however, under the name of Monophysites (q.v.) continued quietly for a century after his death, in the Armenian, Ethiopian, and Coptic churches, when it awoke to new life under the auspices of Jacob Baradæus, who died bp. of Edessa, 588. His followers were called Jacobites, and have perpetuated the Monophysite doctrine in the Armenian and Coptic churches to the present day. See Neander, *Kirchengeschichte*, III., p. 1079, etc. EUTYCHIANS, n. plu. *ū-tik'i-ānz*, heretics of the 5th c., followers of Eutyches; see MONOPHYSITES. EUTYCHIANISM, n. *ū-tik'i-an-izm*, the doctrines of Eutyches; adherence to his doctrine.

EUXENIA, n. *ūks-ēn'i-a* [Gr. *eu*, beautiful; *xenos*, a guest, a friend]: typical genus of *Euxenieæ*, sub-tribe of *Senecionideæ*. E. consists of two Chilian shrubs with aromatic leaves.

EUXINE, *ūks'in* [Gr. *Euxinos*, hospitable]: ancient name of the Black Sea (q.v.). Before receiving this name it was called *Axenos Pontos*, the inhospitable sea, because of the black and turbulent weather so frequently ascribed to it by the ancient poets, and the reported cannibalism of the Scythian tribes who lined its n. shores. It seems to have been called the *Euxine*, or hospitable sea, after the establishment of Greek colonies on its borders, when its waters were thrown open to Greek commerce.

EUYUK, or UYUK: village of Asia Minor, 28 m. s. of the Kizil Irmak river, 75 m. w.s.w. of Amasia; on a small spur of a succession of high hills, ranging n. Though containing only a score of buildings, it is noted for its singular ruins, which have excited all manner of historical conjectures. The remains are those of a large edifice, and comprise blocks of granite of colossal size, which display with remarkable clearness a great variety of sculptures. The building resembles an Assyrian palace in form and divisions, with the upper part of its walls fashioned in clay. The most plausible conjectures are (1) that it was erected by

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artisans, who had been employed in building the palaces at Nineveh, and (2) that it was a temple, erected by Egyptians at the time of their earliest conquests in Asia Minor. If the former be true, the builders here adopted Egyptian figures and emblems, as they did elsewhere; if the latter, they added their own sphinx and human figure sculptures to the usual form of large Assyrian buildings.

EVACUATE, v. ē-vāk'ū-āt [L. *evacuātūs*, emptied out—from *e*, out of; *vacuūs*, empty: It. *evacuare*; F. *évacuer*]: to make empty; to quit; to eject or void; to empty; to withdraw from, as troops from a fortress. **EVACUATING**, imp. **EVACUATED**, pp. **EVACUATOR**, n. -tér, one who, or that which. **EVACUATION**, n. -ā'shūn [F.—L.]: an emptying; a retiring from; voidance; discharge of faeces from the body. **EVACUATIVE**, a. -ā-tīv, that evacuates. **EVACUANT**, a. [F.—L.]: emptying: N. a medicine used for producing evacuation.

EVADE, v. ē-vād' [F. *éviter*, to evade, to escape—from L. *evādērē*, to go forth or out—from *e*, out of; *vādō*, I go: It. *evadere*—lit., to go forth or out]: to avoid or escape by artifice or dexterity; cleverly to escape from; to elude; to slip away; to equivocate. **EVADING**, imp. **EVADED**, pp. —**SYN.** of ‘evade’: to escape; shun; avoid; eschew; prevaricate; shuffle.

EVAGRIUS, ē-vā'grī-ūs: lawyer and historian: b. in Epiphania, Syria, 536. He practiced law in Antioch, became the legal adviser of Gregory, patriarch of that city, and defended him with such ability that he was appointed prefect of the city by the emperor. His influence and popularity were attested by a public festival in his honor on the occasion of his second marriage. He is known chiefly by his *Ecclesiastical History*, an extension of the histories of Socrates and Theodoret, in 6 books, covering the period 431–594. An edition was published by Reading (Cambridge 1720).

EVALUATION, n. ē-vāl'ū-ā'shūn [L. *e*, out of, and *valuation*]: exhaustive valuation.

EVANDER, ē-vān'dēr: semi-mythical Grecian hero of antiquity, according to Roman traditions, son of Hermes, by Carmenta or Tiburtis. About 60 years before the Trojan war, he is said to have led a Pelasgian colony from Pallantium, in Arcadia, to Italy, and to have landed on the banks of the Tiber, and near the foot of the Palatine Hill. Here he built a town, naming it Pallantium, after the one in Arcadia. At a later period, it was incorporated with Rome, and is affirmed to have originated the names Palatinus and Palatum. Tradition represented E. as having done much to introduce the habits of social life among his neighbors; he prescribed for them milder laws, and taught them, among other arts, those of music and writing. To him is ascribed also the introduction of the worship of the Lycean Pan, with that of Demeter, Poseidon and other deities. Virgil represents him as still alive when Aeneas arrived in Latium after the sack of Troy. E. was worshipped at Pallantium in Arcadia, and at Rome.

EVANESCENT—EVANGELICAL.

EVANESCENT, a. *ěv'ā-něs'ěnt* [L. *evanescēn'tem*, vanishing or passing away—from *e*, out of; *vanescō*, I vanish; F. *évanouir*, to vanish]: vanishing; fleeting; momentary; passing away. **EV'ANES'CENCE**, n. *-ěns*, the being liable to pass away; a vanishing; the act of passing away. **EV'ANES'CENTLY**, ad. *-ěnt-lī*. **EVANESCENTI**, prefix, *ěv-a-něs-sěn-tī* [L. *evanescens*]: evanescent. **EVANESCENTI-VENOSE**, a. *-vē'nōs*, in bot., having such a venation that the lateral veins disappear within the margin.

EVANGELIC, a. *ěvăñ-jěl'ik*, or **E'VANGEL'ICAL**, a. *-i-kăł* [F. *évangélisque*—from L. *evangēlicus*—from Gr. *eu*, well, good; *anggello*, I bring tidings, I announce]: according to the doctrines and precepts of the Gospel; orthodox. **E'VANGEL'ICALLY**, ad. *-lī*. **EVANGELIZE**, v. *ě-văñ'jěl-iz*, to convert to Christianity; to instruct in the Gospel. **EVAN'-GELI'ZING**, imp. **EVAN'GELIZED**, pp. *-iżd*. **EVAN'GELIZA'TION**, n. *jěl-i-ză'shūn*, the act of converting to Christianity. **EVAN'GELIST**, n. one who brings good tidings; a preacher of the Gospel; one of the four Gospel writers. **EVAN'-GELISM**, n. *-iżm*, the spreading of the knowledge of the Gospel. **EVANGEL**, n. *ě-văñ'jěl*, good news, especially that of the Gospel—used in poetry. **EVANGELY**, n. *ě-văñ'jěl-ě*, in *OE.*, good tidings; the Gospel message.

EVANGEL'ICAL: adjective applied in general to anything which is marked by the spirit of the gospel of Jesus Christ; e.g. an evangelical sermon, evangelical piety, evangelical views, etc. The term ‘evangelical,’ however, is used by a large portion of the religious community to denote, not merely a spirit or sentiment resembling that of the Savior, but that spirit or sentiment viewed as resulting from, or as necessarily accompanied by, an assured belief in the grand facts of Christ’s redemption. These facts, variously stated and with different emphasis on one or another point, are such as the universal sinfulness and peril of man; God’s gracious redemption of man through the sacrifice of Christ, whose benefits are freely offered to all who will accept them by faith; the regenerating power of the spirit of God, given through Christ, to lead men into the new life of faith and love; a future of rewards and punishments unending, beyond the grave, to be rendered to every human soul, according to the just judgment of God. With these, is involved the acceptance of the authoritative revelation and binding precept of God as given in the Bible, and an acceptance of the scriptural revelation of the one God as the Father and the Son and the Holy Spirit. The word ‘evangelical’ has less strictness and smaller range of doctrine than ‘orthodox,’ while it involves more direct reference to character and life. ‘Orthodoxy’ may be said to include whatever doctrines are held to constitute the only true and complete expression of Christian belief. In England and Scotland, dissenters have generally laid claim to be considered more ‘evangelical’ than the national churches. In the Anglican Church, however, the rise of the Puseyite or Tractarian party has brought into prominence an antagonistic party, resembling dissen-

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ters very much in their theological tenets. This party calls itself, *par excellence*, 'Evangelical,' and has been criticised as expending much of its strength in antagonism to the ritual party and practices.—In Germany, all Protestants call themselves Evangelical, in opposition to Rom. Catholics, on the ground that the Reformers taught the pure gospel of the grace of God in Christ, cleansing it of all human corruptions. The modern orthodox or pietistic party in the German Prot. churches have of late made exclusive claim to the attribute Evangelical, on the ground that they alone hold to the gospel in its actual historical shape. This claim is naturally disputed by the 'liberal' theologians.—In a general doctrinal sense, 'Evangelical' is used in distinction from Rom. Catholic, Unitarian, and Universalist systems; but not as excluding such individual adherents of those systems as show an evangelical or gospel spirit.

EVANGELICAL ALLIANCE: association formed in London, 1846, Aug., to promote a more practical union among Protestants, a closer Christian fellowship, and a wider extension of the Christian faith. At the first meeting about 800 delegates were present, including many eminent men from Great Britain, France, Germany, Switzerland and the United States; and representing Episcopal, Presbyterian, Congregational, Methodist, Baptist, Lutheran, Reformed, Moravian, and other churches. The following summary of doctrines regarded as essential by those who form the alliance was adopted:
1. The divine inspiration, authority, and sufficiency of the Holy Scriptures. 2. The right and duty of private judgment in the interpretation of the Scriptures. 3. The unity of the Godhead, and the trinity of persons therein. 4. The depravity of human nature in consequence of the fall. 5. The incarnation of the Son of God, his work of atonement for the sins of mankind, and his mediatorial intercession and reign. 6. The justification of the sinner by faith alone. 7. The work of the Holy Spirit in conversion and sanctification. 8. The immortality of the soul, the resurrection of the body, the judgment of the world by our Lord Jesus Christ, with the eternal blessedness of the righteous, and the eternal punishment of the wicked. Branch alliances have since been formed in Great Britain, Germany, France, Switzerland, Spain, Belgium, Holland, Italy, the United States, Australia, and among missionaries in Burmah, Siam, China, Ceylon, India, Turkey, Syria, Egypt, Africa, and other distant lands. These national branches have charge of the work in their respective countries; and delegates from them meeting together, form a Protestant 'ecumenical council,' which exercises only moral and spiritual power, to the exclusion of all ecclesiastical authority. These councils have been held at average intervals of 4 or 5 years. That at New York, 1873, Oct., remarkable as the first assemblage in the western hemisphere of Christians from all parts of the world, was attended by more than 500 delegates, many of whom were men very highly distinguished in

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church and state. For ten days, in the midst of large and enthusiastic congregations, they deliberated together on the religious condition of Christendom, Christian union, Christian life, and on Christianity in its relations to unbelief and error, to science, civil government, philanthropy, and the reform of social evils. At the close of the sessions, the council, by invitation, proceeded to Princeton, Philadelphia, and Washington; in all of which places highly interesting meetings were held. In 1887, Dec., the branch Alliance for the United States held, at Washington, D. C., a general conference, which was very largely attended by representative men of all Prot. denominations, who, during three days, earnestly and thoroughly considered the following topics: 1. The present perils of Christianity in the United States. 2. Its great opportunities. 3. The imperative need of the active co-operation of all Christian churches, and the best means for securing it. Some of the results of the E. A., already seen, are: 1. An increase of earnest and systematic work in evangelizing more thoroughly nominally Christian countries, and in establishing Christianity in heathen lands. 2. A growth among all denominations, of Christian fellowship, of co-operation in Christian work, and of effort to secure a more pronounced outward expression of Christian unity. 3. Successful endeavors to promote religious liberty in quarters where it is denied or threatened; for example, in Turkey, Japan, the Baltic provinces of Russia, and some parts of southern Europe.

EVANGELICAL ASSOCIA'TION (sometimes inaccurately called the German Methodist Church): a union of Christian churches, organized in 1800. The Rev. Jacob Albright (1759-1800, b. Penn.) of eastern Penn. began, about 1790, to preach among the Germans around him, in order to raise their standard of doctrinal belief and of moral conduct. He continued this work successfully for 10 years, gradually enlarging the range of his travels and the number of persons brought under his influence. At length, to meet the exigencies of the case, he gathered his scattered converts into little companies for mutual comfort and help. These were soon found to need some bond of union for edification and strength. A general meeting was therefore, called, to consider the best methods for promoting their welfare and work. The first thing done by the assembled people was to choose Mr. Albright as pastor and bishop; ordaining him to the ministry, and clothing him with authority over themselves, in subjection to the Scriptures as their only rule. Subsequently, they adopted a creed and form of church order, in accordance with their views of Scripture truth. The creed is described as steering between Calvinism and Arminianism; in church order, they resemble the Meth. Episc. Church, their ministers being itinerant, and having among them no higher order than that of 'elders.' As their numbers increased they organized annual conferences; and, since 1843 have held, every four years, a general conference of delegates from the annual conferences. They have presiding elders and bishops; both classes being elected for a term of four years,

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at the expiration of which, unless they are re-elected, their authority ceases. For the first 25 years they encountered many difficulties and great opposition; but, since that time, have had a prosperous course. Their membership is no longer confined as at first to German immigrants and their German-speaking descendants. As from the beginning they denounced slavery, they made progress only in the free states and Canada. They prosecute the work of missions at home and, to some extent, also abroad. They are friends of education, and sustain several literary institutions, among which is a college at Naperville, Ill. They forbid the use of intoxicating liquors as a beverage by their ministers and members; and exclude the dealers in them from church fellowship. In 1891 official reports showed 619 local and 1,227 itinerant preachers; 2,062½ chs.; 150,234 memb.; 2,535 Sunday schools, property worth \$6,041,268. 1902: Ministers, 920; churches, 1,659; communicants, 98,641.

EVANGELICAL COUNSELS: in the Rom. Cath. Church, certain admonitions taken from the N. Test. and recommended for the observance of all who wish to attain a superior degree of holiness. They are classed as non-obligatory rules, in contra-distinction to the commandments and precepts (obedience to which is held to be an absolute necessity), and originally took the form of 3 vows: to renounce riches for voluntary poverty, pleasure for perfect chastity, and self-will and love of power for obedience to a religious superior. Subsequently the vows were increased to 12. (See Matt. v. 29, 35, 39, 42; xix. 11, 21; xxv. 21; Lk. xiv. 26; xvii. 10; I. Cor. vii. 10, 25; I. Tim. iv. 3.)

EVANGELICAL UNION: religious body constituted in Scotland 1843 by the Rev. James Morison of Kilmarnock (now Dr. Morison of Glasgow), and other three ministers (with their respective adherents), who had been separated from the United Secession Church for doctrinal views, of which the fundamental and determining article was the strict universality of the Savior's atonement. Coeval with the body is its Theological Academy, presided over by Dr. Morison, and attended by more than 20 students annually. They were soon joined by a number of ministers and churches of the Congregational Union of Scotland, and have since extended themselves considerably in Scotland and the n. of England. Their church government is congregational, though many congregations have ruling elders. Their doctrinal views are exhibited in an authorized publication, *Doctrinal Declaration*, 1858. See MORISONIANISM.

EVAN'GELIST: literally, bringer of good tidings, designates, in the New Testament, a person appointed by an apostle to itinerate among the heathen, and so prepare the way for resident Christian instructors. The evangelist, therefore, had no particular flock assigned to him, and is thus distinguished from bishops, or pastors, whether of larger or smaller territories. Later in the history of the early church, the evangelist figures, according to Eusebius, as 'a deliverer of the written gospels to those who were

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ignorant of the faith.' This may possibly imply that he acted as a colporteur, by distributing copies of the gospels, or that he read them to the heathen, and so made them familiar with their contents. In modern usage, E. has come to signify one of a class of revivalists, preaching zealously for a longer or shorter period in a place, often under direction of the local minister, sometimes independently, and aiming by pungent sermons and fervent appeals to bring to pass a multitude of immediate conversions. In the Church of England, and affiliated churches, these are known as *Missioners*, and have had great success in recent years.—The word evangelist is specially applied to the four writers of the life and gospel of Jesus Christ, these being evangelists (' bringers of good tidings ') *par excellence*.

EVAN'GELISTS, SYMBOLS OF THE FOUR: symbols in sacred art. *Jointly*: 4 scrolls placed in the 4 angles of a Greek cross; 4 books (the Gospels); 4 rivers rising in Paradise; 4 beasts (Rev. iv. 7), typifying Christ's Incarnation, Passion, Resurrection, Ascension; the tetramorph, or union of the 4 attributes of the evangelists into a single winged figure; 4 human figures, but with animal heads, each holding an open book. *Separately*: MATTHEW: cherub; human figure, head in halo, carrying tax-collector's bag; human figure writing in a book from an angel's dictation; MARK: lion; lion flying with double wings, head in halo, fore-claws holding book; lion-head, human shoulders and arms holding book; wings; figure in pontificals of a Greek bp.; LUKE: ox; head of ox with wings; ox-head with wings flying between 5 stars; artist painting the Virgin's portrait; hooded figure seated on an ox and writing in a book; JOHN: eagle; eagle soaring with double wings, head in halo; human figure with eagle-head in halo; aged man, white hair; young man, beardless; human figure writing, devil stealing inkhorn; draped figure, pensive, bearing the sacramental cup from which a serpent is emerging.

EVANIA, n. ē-vā'ni-a [Gr. *euanios*, taking trouble easily; *eu*, easily; *ania*, grief, trouble]: typical genus of *Evaniidæ*, a family of hymenopterous insects, tribe *Entomophaga*. They have the abdomen attached to the upper surface of the meta-thorax, and the antennæ straight.

EVANISHMENT, n. ē-vān'ish-mēnt: a vanishing or disappearing from sight; disappearance; evanescence.

EVANS, ēv'ans or ēv'anз, Lieutenant-General Sir DE LACY, G.C.B.: 1787–1870, Jan. 9; b. Moig, Ireland. He entered the British army as ensign 1807; in 1812, joined the 3d light dragoons, with whom he saw much Peninsular service. In 1814, he was brevet lieut. in the war with the United States. He was next at Waterloo. In 1830–1, he sat in parliament for Rye, and 1833 was elected on the liberal interest for Westminster, which he represented until 1841. The command of the British auxiliary legion in aid of the cause of the young queen of Spain, was offered to E., and he was allowed by his constituents to accept it without vacating his seat for Westminster. E.'s principal military ex-

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ploits at the head of the British Legion were the storm and capture of the Carlist lines of Ayetta, near St. Sebastian, 1836; the storm and capture of Irún; and the capture of Oyarzun and Fontarabia. On declaration of war against Russia, he was appointed to command the 2nd division of the army sent out to Crimea, with the rank of lieut.-gen. In 1855, Feb., he received the public thanks of the house of commons, for his services in the Crimea.

EVANS, FREDERICK WILLIAM: elder in the Society of Shakers; b. Leominster, England, 1808, June 9. He was brought up on a farm, came to the United States with his father, 1820; learned the hatter's trade; taught himself to read, and studied the works of Owen, Fourier, and other advocates of social reform. After a brief visit to England, he joined the community of Shakers at Mount Lebanon, N. Y., 1850, June 3, and subsequently became assistant elder in the 'North Family' (1838), first elder of three 'families' (1858), and the leader of the sect in the United States. Evans lectured frequently on the dogmas of his sect, and published *Compendium of Principles, Rules, Doctrines, and Government of Shakers*, with biographies of early and leading Shakers (1859); *Autobiography of a Shaker*, and *Tests of Divine Revelation* (1889), etc. He died, 1893, March 6.

EVANS, JOHN: an American philanthropist; 1814, Mar. 9—1897, July 3; studied medicine and practised in Ottawa, Ill. In 1848 he accepted a professorship in the Rush Medical College, Chicago, in which city he acquired a large fortune by investments in real estate. He founded the Northwestern University, and endowed two chairs there with \$50,000 each. He was appointed governor of Colorado Territory, 1862, and later founded the University of Denver, giving \$200,000 toward its construction and largely endowing it. He gave liberally for the erection of the Grace Meth. Epis. Church in Denver, and aided nearly every educational institution in Colo.

EVANS, MARIAN (*nom de plume*, 'George Eliot'): one of the greatest of English novelists, and probably the foremost literary woman of her age: 1820, Nov. 22—1880, Dec. 22; b. Griff, near Nuneaton, youngest daughter of a Warwickshire land-agent. Her education, begun at Coventry, embraced music, French, German, Italian, Greek, and Latin; Spanish and Hebrew were later acquisitions. Her translation of Strauss's *Leben Jesu*, published 1846, was her first literary effort. Her reading in history, science, speculative philosophy, and theology was very extensive; and when in 1851 she settled in London as assistant to Dr. Chapman, editor of the *Westminster Review*, Herbert Spencer has testified that she 'was already distinguished by that breadth of culture and universality of power which have since made her known to all the world.' Her translation of Feuerbach's *Essence of Christianity* appeared 1853. In 1856, G. H. Lewes forwarded to the Messrs. Blackwood the first instalment of *The Scenes of Clerical Life*, which appeared next year in *Blackwood's Magazine*.

with the now familiar signature of 'George Eliot.' These proclaimed with great distinctness the advent of a new novelist of fresh and original power. It was from the first well understood that the signature was a mere *nom de plume*; and no little curiosity was excited as to the personality of the author unknown. That feeling was much deepened by the publication, 1858, of the novel of *Adam Bede*, which attained an immense success, and at once secured for the writer almost undisputed rank with the most eminent novelists of the day. This was followed, 1859, by *The Mill on the Floss*, which amply sustained the reputation of the writer; and, 1861, by *Silas Marner, the Weaver of Raveloe*, one volume. In 1863, *Romola*, an elaborate historical novel of Italian life, illustrating the times of Savonarola, was published in the *Cornhill Magazine*. This work has never had the popularity of its predecessors, but was considered by some the greatest effort of the author. It had by this time become certain that Miss E. was the 'George Eliot' of these works; and by not a few competent critics a place had been assigned her at the very summit of this branch of literature. *Felix Holt, the Radical*, published 1866, was almost everywhere received with acclamation. *Middlemarch, a Study of English Provincial Life*, published at intervals in 8 divisions, 1871-2, enhanced the author's great reputation. It has sometimes been spoken of as her chief triumph; though the palm is generally assigned to *Adam Bede*. *Daniel Deronda* was published at intervals in 1876. In its chief characters are sympathetically idealized the history, character, and aims of the Hebrew race—a unique and daring artistic conception. Of the poems, *The Spanish Gypsy* was published 1868; *Agatha*, 1869; *the Legend of Jibal*, 1870; and *Armgart*, 1871. Meanwhile the distinguished authoress had for years been known to a wide circle of friends as the wife of George Henry Lewes (q.v.), who died 1878. In 1879 she published a vol. of essays, *The Impressions of Theophrastus Such*; another vol. of essays appeared 1884. In 1880 she married Mr. J. W. Cross. See her *Life*, drawn almost wholly from her letters and journals, by Mr. Cross (1885); and a short life by Miss Blind (1883). Her poems, though marked by many of the highest qualities of true poetry, have missed success. They and her novels, whether those founded on memories of English life in the Midland Counties, or the romances of pure historic imagination, have many qualities in common. 'George Eliot's' work is remarkable not only for nobility of tone, wealth of pregnant suggestion, and subtlety of insight, but for tenderness of feeling, keen sense of humor, delicacy of treatment, and width and variety of sympathy. Earnest purpose is manifest; but the lighter gifts of the novelist are used with grace and effect. The style is pure and forcible. The interest centres largely in character struggling with circumstance, sometimes succumbing to fate, and generally molded or modified by surroundings. Egoism is everywhere revealed as the great canker of life. 'George Eliot' had a keen sympathy with the ethical elements of the

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EVANS, THOMAS WILLIAMS: an American dentist; 1823, Dec. 23.—1897, Nov. 14; b. in Philadelphia, Pa. After working for some time with a goldsmith and dental plate-maker, he studied dentistry, and made a specialty of saving teeth by filling. In 1848 he was called, as the most skilful American dental surgeon, to go to Paris to attend to the teeth of President Louis Napoleon; and while there acquired a large fortune, which he bequeathed to trustees to establish a museum and institute in Philadelphia. He was the organizer and an influential promoter of the U. S. Sanitary Commission in the civil war; a founder of the French Red Cross Society, and the director of its ambulance corps in the Franco-Prussian war.

EVANSTON, *ev'an-^z-ton*: town of Cook co., Ill.; on Lake Michigan; on the Milwaukee division of the Chicago and Northwestern railroad; 12 m. n. of Chicago. It is delightfully situated and laid out, is lighted with gas and electricity, has the Holly system of waterworks, 6 churches, 1 private bank, 2 weekly newspapers, and numerous costly residences. It is the seat of the Northwestern Univ. (Meth. Episc.) founded 1854, largely endowed and of high repute, with a library of 25,000 vols. and a grand museum. It is the seat also of the Garrett Biblical Institute; and of the E. College for Ladies, founded 1871. A state law prohibits the sale of intoxicating beverages within 4 m. of the univ. buildings. Pop. (1900) 19,289.

EVANSVILLE, *ev'an-^z-vil*: city, cap. of Vanderburg co., Ind.; on the O. river, 192 m. above Cairo and 185 m. above Louisville; on the Evansville and Terre Haute, Louisville Evansville and St. Louis, Louisville and Nashville, and Lake Erie and Southwestern railroads; a port of entry, and the second city in the state. It is on a high bank at a bend of the river, midway between the falls and its junction with the Mississippi; is the geographical centre of a rich and fertile agricultural region, accessible in every part by navigable streams, as well as by lines of railroad; and is in the midst of the great coal fields of the west and southwest; hence, it has unusual advantages as a manufacturing and shipping point. In 1890 it had 482 manufacturing establishments, which employed a capital of \$9,166,859, paid \$3,197,928 in wages to 7,435 hands, and yielded products valued at \$12,809,334. The principal industries were 7 stove and hollow-ware works, 5 engine and machine shops, 3 plow factories, 5 boiler yards, 14 sheet iron, tin, and copper works, 14 saw mills with extensive lumber yards doing annual business of \$1,500,000, 23 carriage and wagon factories, 17 furniture factories, 10 coopering houses with a capacity of 250,000 barrels per annum, 5 marble yards, 19 cigar factories, 5 brick-yards, 4 breweries, 3 malt-houses, 7 flour-mills, 6 tanneries, 3 soap-factories, 4 broom-factories, 16 saddlery shops, large woolen and cotton mills, 1 saw factory and 1 fireproof safe factory. In 1902, there were 3 national banks, cap. \$1,-650,000; 1 private bank and 1 savings-bank; U. S. custom-

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'Religion of Humanity;' her Positivist beliefs she does not obtrude on her readers. These beliefs, towards which she seems to have been tending since about 1829, were confirmed after 1851, during her assistant editorship of the *Westminster Review*, by her intimacy with Herbert Spencer, Mill, and others of that school. Her example has done much to forward the cause of woman's culture, and her personal character was genial.

EVANS, OLIVER: 1755–1819, Apr. 25; b. Newport, Del.: inventor. He learned the wheelwright's trade, invented a machine for making card teeth when 22 years old, became associated with his brothers in a flour-mill when 24, and within a few years devised improvements for his business, comprising an elevator, hopper, drill, and descender, which radically changed the process of manufacturing flour. As early as 1772 he began experimenting to produce a substitute for animal power in moving wagons, and in 1780 completed the first high-pressure steam engine in the United States. During 1803–4, he planned and built for the Philadelphia board of health, the first steam dredging machine used in the United States; and, by connecting his engine by pulleys and bands with four wooden wheels placed beneath the scow, and also with a paddle wheel behind it, was able to move his singular apparatus equally well over land and water. He thus became the originator of locomotion by steam power. He was desirous to build a railroad between Philadelphia and New York, but was prevented by lack of money.

EVANS, ROBLEY DUNGLISON: an American naval officer; b. 1846, Aug. 18; was graduated at the U. S. Naval Academy, 1863; promoted ensign, 1863, Oct. 1. During the civil war he participated in the assault on Fort Fisher, 1865, Jan. 15, and in the land engagement received four wounds. He was promoted lieut., 1866, July 25; lieut.-commander, 1868, Mar. 12; commander, 1878, July. He was in command of the *Yorktown* at Valparaiso, Chili, 1891, during the strained relations between the United States and that country. On 1893, June 27, he was promoted capt., and on 1898, July 3, commanded the *Iowa* in the battle off Santiago de Cuba, in which the Spanish fleet was destroyed. He became rear-admiral, 1901, and in the same year published *A Sailor's Log*.

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house and post-office, U. S. mar. hospital, 2 theatres, several public halls, including one exclusively for temperance meetings and purposes, the Willard library and art gallery (endowment \$500,000), city hall, court-house, 3 libraries, and 5 daily and 5 weekly newspapers. There are 40 churches: Meth. Episc., 9; Bapt., 7; Presb., 5; Rom. Cath., 5; Lutheran, 3; Prot. Episc., 3; German Evang., 2; Jews, 2; Christian, German Evang. Assoc., Ref. Ch. in the U. S., Free Meth., each 1. There are also 15 public school buildings, including a high school for white pupils and another for colored, and 11 denominational schools. The public lands in the s.w of Indiana Terr., along the O. and Wabash rivers, were surveyed 1806–09. As soon as they were offered for sale, Col. Hugh McGary, of Ky., secured patents for a large tract that included the site of E., erected the first house on the banks of the O. 1812, and began clearing the land. Ind. was admitted into the Union 1816, Dec., and in the following spring Col. McGary sold half of his town site to Gen. Robert M. Evans and James W. Jones, by whom it was named E. It was incorporated as a town 1819. In 1900 all manufactures reported 705 establishments, 7,279 persons employed, \$10,059,375 capital, and an annual output valued at \$14,193,320. Pop. (1860), 11,484; (1890) 50,674; (1900) 59,007.

EVAPOMETER: same as EVAPOROMETER.

EVAPORATE, v. *ě-văp'ō-rāt* [L. *evapōrātus*, dispersed in vapor—from *e*, out of; *vapōr*, vapor; It. *evaporare*: F. *évaporer*, to evaporate—*lit.*, to disperse in *vapōl*]: to pass off in vapor or fumes; to dissipate in fumes; to give vent to; to pour out in words or sounds, not in action; to pass off without effect. EVAP'ORATING, imp. EVAP'ORATED, pp. EVAP'ORA'TION, n. *-rā'shūn* [F.—L.]: the slow conversion of a fluid into vapor or steam, generally invisible; the state of flying off in fumes; vent. EVAP'ORABLE, a. *-rā-bl*, that may be converted into a vapor. EVAP'ORATIVE, a. *-rā-tīv*, causing evaporation. EVAP'OROM'ETER n. *-rōm'-ě-tēr* [Gr. *metron*, a measure]: an instrument for measuring the quantity of fluid evaporated in a given time.

EVAPORATION.

EVAPORATION: conversion of a fluid or solid into vapor. Steam, vapors of alcohol, camphor, iodine, etc., are familiar instances. All fluids are surrounded by vapor at common temperatures; but for every substance there is a limiting temperature, below which no evaporation takes place. The pressure, or tension, of a vapor depends mainly on the nature of the substance evaporated, and the temperature to which it is raised. The full amount of vapor, however, is not produced instantaneously, and, therefore, in general, *time* is an element in the question as well as temperature. See DIFFUSION.

The boiling-point (q.v.) is the temperature at which vapor is freely given off--i.e., at which the tension of a vapor of a substance is equal to the atmospheric pressure. Dalton gave an empirical law, which is at all approximate only for temperatures near the boiling-point: 'The tension of a vapor of a substance rises in *geometric*, as the temperature rises in *arithmetic*, progression.' It is sufficient here to notice, that the tension increases very rapidly with the temperature. Some curious consequences result from this. Thus, water boils at 212° F., under a pressure of 30 inches, or at that temperature the tension of its vapor is *one* atmosphere. At 162° F., or 50° below its boiling-point, its vapor has a tension of 10 inches of mercury, and it will, therefore, boil, if placed in the receiver of an air-pump, as soon as two-thirds of the air have been extracted.

If a little water be boiled in an open flask till the steam has displaced a great part of the contained air, and the flask be then tightly corked, the water will gradually cool. If the flask be now dipped in *cold* water, boiling recommences, the cold water having condensed some of the vapor, and so diminished the pressure on the contained liquid. Dip the flask in *hot* water, and the boiling ceases. These appearances may be obtained several times in succession.

A fluid cannot be heated above its boiling-point, at the ordinary pressure of the atmosphere; but if it be heated in a closed vessel, the tension of the vapor produced is to be taken in addition to the former pressure, and the boiling-point rises with it. Thus, when the pressure is equivalent to 2 atmospheres, the boiling-point of water is raised 40° F. At such temperatures, its solvent powers are greatly increased. Many minerals found in fine crystals are supposed to have been deposited from water which had dissolved them in large quantities, under the combined influences of pressure and temperature. Papin's Digester (q.v.) depends upon this principle.

The amount of E. from a fluid depends on many circumstances. As, except in the case of actual boiling, it takes place only at the surface, the amount of surface exposed is an important consideration where rapid and copious E. is required, as in steam-boilers, salt-pans, etc. When, on the contrary, it is desirable to prevent E. as much as possible, a layer of oil, preventing direct contact with the air, is of great use. The rate of E. depends also on the pressure, and varies, according to Daniell, nearly inversely as

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the latter. His experiments, which appear trustworthy, were made in an exhausted receiver, and the vapor was removed as it was formed.

In the conversion of a fluid into vapor, a quantity of heat disappears; i.e., is required to produce and maintain the gaseous state. Thus, the temperature of steam at 30 inches is the same (to the thermometer) as that of the boiling water from which it comes off; but the heat necessary to convert a pound of water at 212° into steam at 212° , would raise nearly 1,000 pounds of water from 60° to 61° . See HEAT. When, therefore, a fluid evaporates, the vapor carries off heat from the fluid, and thus E. produces cold—a fact of daily observation. Porous earthenware jars are used to cool water in summer in this climate; and in India, ice is procured by exposing water in shallow pans, laid on straw, to the combined effects of evaporation and radiation at night.

On the same principle depends Sir John Leslie's method of freezing water. The water is placed in a flat porous dish, over a large surface of strong sulphuric acid, and the whole covered with the receiver of an air-pump. When a good vacuum has been produced, there is a rapid E., and the acid eagerly absorbing the vapor as it is formed, the process goes on without further working of the pump, till the residual water has become a solid cake of ice. A most extraordinary example of this production of cold is afforded by the freezing of water on a white-hot plate—by no means a difficult experiment. A platinum capsule is heated nearly to whiteness by a lamp placed underneath; a little water, mixed with sulphurous acid, which is an extremely volatile liquid (indeed it is gaseous at ordinary temperatures and pressures), is poured upon the plate. The acid instantly evaporates, and the cold produced freezes the water, which can be dropped from the hot plate on the hand as a lump of ice.

Another remarkable instance occurs in the formation of solid carbonic acid. The liquid acid is forced by the pressure of its own vapor in a fine stream into the air from a nozzle in the strong iron vessel in which it is contained. It evaporates so rapidly in air that a portion of the stream is frozen, and the delicate snowlike mass can be collected by proper apparatus.

In meteorology, E. is recognized as one of the most effective of all the gigantic processes that are continually going on around us. Watery vapor is continually rising invisible in the air; meeting with a colder stratum of the atmosphere, or the cold ridge of a mountain, it becomes condensed into mists or clouds; the fine particles of these unite into larger groups, and fall as rain, hail, or snow—to be again evaporated by heat from the moist ground, or from rivers, lakes, and seas. Even when otherwise invisible, its presence may be detected by its deposition as dew (q.v.), and, according to Clausius, in the blue of the sky, and the gorgeous tints of sunrise and sunset. There is little doubt of its being also intimately connected with the scintillation of the fixed stars: see SCINTILLATION. Atmospheric electri-

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city is largely due to E. directly as well as indirectly, on account of the amounts of vapor contained in different currents of air. It is matter of everyday observation how much the drying of the ground, or E. generally, is promoted by a brisk wind. This finds its explanation in the constant removal of the vapor as it is formed, the diffusion of the vapor taking place into comparatively dry air instead of the moist atmosphere into which it would take place in a calm. See RAIN: ATMOSPHERIC ELECTRICITY.

In agriculture, E. is the principal agency in the removal of an excess of water from land not naturally or artificially drained. In retentive soils, and those resting on impervious subsoil, the quantity to be thus removed is often very great, especially in the spring when the ground is soaked with melted snow and frequent rains, and in summer after heavy showers. The E. of this water proceeds slowly, and causes a loss to the soil of an immense amount of solar heat. This makes the ground cold and greatly hinders the farmer by delaying planting, retarding the growth of crops, and favoring early frosts in autumn. E. takes place much more rapidly from soils covered with plants than from those destitute of vegetation, and is increased by a rising and diminished by a falling temperature. In certain soils E. proves detrimental to plants by forming an almost impervious crust upon the surface, while in others it hardens the land to such a degree as to injure crops and prove a serious obstacle to cultivation. The remedy for the evils resulting from excessive E. of water from the soil lies in a thorough system of drainage. See DRAINAGE. (For evaporation or desiccation of fruits, see FRUIT).

EVARTS, *ev'arts*, JEREMIAH: 1781, Feb. 3—1881, May 10; b. Sunderland, Vt.: religious editor and promoter of Christian missions. He graduated at Yale 1802, taught school, studied law, was admitted to the bar 1806, and practiced in New Haven four years. He then became editor of the *Panoplist*, a religious (Cong.) periodical of Boston, treas. of the A. B. C. F. M. 1812, editor of the *Missionary Herald*, which succeeded the *Panoplist* 1820, and sec. of the A. B. C. F. M. 1821, retaining the latter office till death. Among his publications were numerous essays in defense of the rights of the Indians. He was father of William Maxwell Evarts.

EVARTS, WILLIAM MAXWELL, LL.D: lawyer and statesman: b. Boston, 1818, Feb. 6; son of Jeremiah E. He took a preparatory course at the Boston Latin School, graduated at Yale 1837, studied law at the Harvard Law School and with Daniel Lord in New York, was admitted to the bar 1841, and rapidly attained distinction. In 1849, Apr. he was appointed deputy U. S. dist. attor. for the New York city district, and held the office four years. He acted as dist. attor. during the illness of the incumbent 1851, and successfully conducted the prosecution of the persons engaged in the Cuban filibustering scheme known as the 'Cleopatra expedition,' Apr., and the same year made an argument in favor of the constitutionality of the Metropolitan Police

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Act. In 1853 he resumed private practice, and as counsel for the state of N. Y. gained wide reputation by his conduct of the celebrated Lemmon slave case before the supreme court and the court of appeals. He became a republican soon after the organization of that party; was a candidate with Horace Greeley before the republican caucus for U. S. senator, when Ira Harris was chosen 1861; was leading counsel employed by Pres. Johnson when impeached by the house of representatives 1868, Apr.—May; was attor.gen. of the United States under Pres. Johnson 1868, July—1869, Mar. 4; and was appointed by Pres. Grant counsel of the United States before the tribunal of arbitration at Geneva to settle the ‘Alabama’ claims 1872. To his clear and unanswerable presentation of the disputed claims of American citizens was due, in great measure, the decision in favor of the United States. In 1875 he was senior counsel of Henry Ward Beecher in the suit brought against him by Theodore Tilton in Brooklyn; 1877, the republican advocate before the electoral commission; 1877–81 sec. of state of the United States; 1881 United States delegate to the international monetary conference in Paris; and 1885, Jan. 21. was elected U. S. senator from N. Y. for the term ending 1891, Mar. 3. He is conceded to be one of the most eloquent advocates in the United States, has been engaged in some of the most celebrated trials of his day, and for many years had been employed in cases in which large corporations were parties or interested. He is known also as a public orator, and delivered memorable addresses in eulogy of Chief-Justice S. P. Chase at Dartmouth College 1873, June 25; on the 100th anniversary of American independence at Philadelphia 1876, July 4; at the unveiling of the statues of William H. Seward and Daniel Webster in New York; and at the dedication of the Bartholdi Statue of Liberty, 1886, Oct. 28. He received the degree LL.D. from Union College 1857, Yale Univ. 1865, and Harvard Univ. 1870. D. 1901, Feb. 29.

EVASION, n. *ē-vā'zhūn* [F. *évasion*—from L. *evasiōnem*—from L. *evāsūs*, gone out or forth—from *e*, out of; *vāsus*, gone or entered (see EVADE)]: the act of avoiding or eluding—applied particularly to speech; a shift; a subterfuge. **EVA'SIVE**, a. *-sīv*, using artifice to escape or avoid; shuffling. **EVA'SIVELY**, ad. *-lī*. **EVA'SIVENESS**, n. *-nēs*, the state or quality of being evasive.—**SYN.** of ‘evasion’: prevarication; equivocation; shuffling; eluding.

EVE, n. *ēv* [Heb. *chavah*, Eve, literally meaning life]: wife of Adam, the first man; the mother of all living: see **ADAM AND EVE**.

EVE, n. *ēv*, or **EVEN**, n. *ē'ven* [contr. for **EVENING**, which see: AS. *aefen*; Icel. *aptan*; Ger. *abend*]: the close of the day; the night before a holy-day, as Christmas *eve*; time immediately preceding any important event.

EVECTICS, n. *ē-vēk'tīks*: in *old med.*, that branch of medical science which treats of the method of acquiring a good habit of body.

EVECTION, n. *ē-vēk'shūn* [L. *evēctiōnem*, a carrying

EVELYN—EVENING PRIMROSE.

out]: in *astron.*, an inequality of the moon's motion in its orbit, resulting from the combined effect of the irregularity of the motion of the perigee, and alternate increase and decrease of the eccentricity of the moon's orbit: see LUNAR THEORY.

EVELYN, *ev'ē-līn*, JOHN: 1620, Oct. 31—1706, Feb. 27; b. Wotton, seat of the Evelyn family, in Surrey. He was educated at the free school of Lewes, and at Balliol College, Oxford. In 1640, he entered the Middle Temple, and in the following year, prompted by the ominous appearance of public affairs, and after having witnessed the trial of Strafford, he set out for the continent, returning, however, in the autumn. In 1642, upon offering his services to Charles I., he was accepted as a volunteer in Prince Rupert's troop, but 1643 he again went to the continent, where he mainly lived for eight years. After 1652 he settled in England, where he lived studiously and in private till the Restoration, after which he was much employed by the government. On the organization of the Royal Soc., he became one of the first members, and was an industrious contributor to its Transactions. He succeeded 1699 to the family estate at Wotton, and there, after a long studious, and highly useful life, he died.

His principal works are—*Sculptura, or the History and Art of Chalcography and Engraving on Copper*, 1662; *Silva, or a Discourse of Forest Trees, etc.*, 1664; and his *Memoirs* (published 1818), to which E. owes celebrity. They are in the form of a diary, and continued during a period of about 70 years—and these the most dramatic in the recent history of England. They are of inestimable value.

EVEMERUS, or EUHEMERUS: see EUHemerism.

EVEN, a. *ē'vn* [Ger. *eben*; Dut. *even*; Icel. *jafn*, equal, plain; L. *aequus*, even]: having a flat or smooth surface; level; not rough; equal; calm; not easily disturbed; balanced or settled; not odd, as a number: AD. or CONJ. in like manner or degree; precisely the same; at the very time; so much as; denoting an increase, addition, or slight exaggeration; denoting emphasis, as, 'I, even I': V. to level; to lay smooth; to place in an equal state. EVENING, imp. *ē'vn-īng*. EVENED, pp. *ē'vnd*. EVENLY, ad. *ē'vn-lī*. EVENNESS, n. state of being level or smooth. EVEN-HANDED, impartial; just. EVEN-KEEL, said of a ship having the same draught of water fore and aft.

EVEN, n. *ē'vn*: for EVENING, which see. EVEN-SONG [AS. *æfen-sang*, vespers (see EVE)]: vespers; in the *Book of Common Prayer*, evening service as distinguished from 'Matins' or morning service—referring to the time when intoning the service was nearly universal. EVEN'TIDE [AS. *tid*, time, season]: the evening.

EVENING, n. *ē'vn-īng* [Dut. *avend*; Ger. *abend*, the sinking of the day: Swiss, *aben*, to fall off—from Ger. *ab*, off, away]: the close or last part of the day; the beginning of the night or darkness; the decline or latter part of life: ADJ. relating to or at the close of the day.

EVENING PRIMROSE: see ENOTHERA.

EVENING SCHOOLS.

EVENING SCHOOLS: helps toward popular education. They either take the form of lectures or lessons, carrying further the education received at school; or they aim to supplement defective early training, or, it may be, to give the simplest rudiments of elementary instruction to adults under the disadvantage of being pupils for the first time in their lives. The former are found chiefly in connection with mechanics' institutes, now very numerous in Great Britain, and extending in the cities and large towns of the United States—a most important educational agency; or with existing day schools, and congregational organizations; while the latter more frequently fall under the head of parochial missionary work, or are connected with factories. These latter constitute the class of evening schools which now engage most interest in England and which present the greatest difficulties in working.

The total number of E. S. of this humbler class (under govt. inspection) in England and Wales in 1881, was about 1,561; of these, 875 were conducted by the National Soc. or the Church of England, 33 by the Wesleyans, 277 undenominational, 63 Rom. Cath., and 313 by School-boards. The total numbers of scholars in attendance was 52,530, of whom 42,638 were male. In Scotland, *primary* E. S. are not so usual as in England, education being more generally diffused. The first E. S. proper, in Britain, for boys and girls who had to work all day for a livelihood, was founded in Bristol, Eng., 1806. Her majesty's inspectors, the Royal Commissioners (1861), and the clergy of all denominations, strongly recommend the extension of this agency. 'If the education of the country were in a good state,' say the commissioners, 'evening schools would be nearly universal, and would serve to compensate the scantiness of the instruction given in day schools, by giving more advanced instruction to an older class of scholars.'

State Aid, and Voluntary and Paid Teachers.—Many educationists have come to the conclusion, that the hope of retaining children in school until they have obtained as much instruction as is requisite for their guidance in life, is vain, and consequently look to E. S. as an indispensable part of a national system of education, and consider them entitled to look to the state for encouragement and support to an equal extent with day schools. Bp. Hinds was the first *publicly* to suggest (1839) that evening schools fairly come within the sphere of state action in Great Britain. The recent inquiries have brought out that the majority of those who frequent existing evening schools have never received any elementary instruction, or have forgotten what they once knew, and that a large proportion are either adults or adolescent young men and women. They attend for the purpose of learning to read, write, and cipher. Though in many instances, especially where no fee is charged, the irregularity and unpunctuality of the attendance are great, yet in the majority of cases there is an earnest desire on the part of the pupils to benefit by the instruction. It is a question of some national importance how far schools of this supplementary class should be left to pri-

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vate philanthropy. It is a question also, to some extent implied in the other, whether the peculiarly delicate work required in E. S. is not more efficiently discharged by voluntary than by paid laborers.

1. As to the first question, it may be safely said, that all would desire to see those wholesome channels of benevolence which connect the poor and the rich free from government interference; but if, in our devotion to a theory, we neglect the work, it becomes the duty of the state to see to it, to the extent of encouragement at least, if not of direction. Such schools are now aided by the British government. State aid will be found beneficial not so much in schools for ignorant adults, as in confirming the education of the primary school by the establishment of E. S. for *boys and girls*. There is active benevolence enough abroad, in England and the United States, to overtake the ignorance of the *adult* population, if properly stimulated and led by the various religious bodies. It is to be noted that in practice, separation of scholars according to age is desirable; e.g., of boys and girls 13-18 years of age, from men and women.

2. As to the second question: in those E. S. which are only a continuation of the day school, the same method will generally be found to suit as in the primary schools; therefore it seems advisable that they should be conducted with state aid by paid certificated teachers, acting under managers. But schools frequented by adults, for the elements of reading, writing, and arithmetic, require more delicate handling, and greater consideration of individual character and wants; and in such cases, voluntary effort under religious or merely philanthropic motives appears the best agency. To improve the method of volunteer teachers in these schools for adults, there might be appointed over each designated district an organizing master, to itinerate among the schools, giving the benefit of his superior knowledge of method.

Subjects and Method.—As to subjects to be taught, that class of E. S. which continue the work of the day school, should include in their scheme of practical instruction the elements of those sciences which bear most directly on life, such as social economy and the laws of health. E. S. of the humbler and more urgent sort will necessarily confine themselves to reading, writing, and arithmetic. The short period of attendance requires that *much* be done rather than *many things*. Through a well-constructed course of reading-books for adults, all the general culture and specific information attainable will best be given. See EDUCATION, NATIONAL OR STATE: ETC.

In other countries of Europe, E. S., where they exist, have in view mainly the continuance of the education received in primary schools. In France, however, the wants of untaught adults have been provided for by the establishment by law of evening schools suited to them. In all the states of Germany, provision is made more or less in the country districts, and always in the large towns, for continuing the instruction given in the primary schools.

EVENT.

Schools for those who wish to learn reading and writing for the first time seem scarcely to exist, probably because not needed. The schools which do exist have an affinity to mechanics' institutes. The instruction is given on Sundays and holidays, and in many places also on one or two evenings in the week. But Sunday instruction alone seems to have been originally contemplated. See SUNDAY SCHOOLS. The subjects taught are the ordinary branches, with geography, free-hand and geometrical drawing, geometry, and in some cases the elements of natural science and the laws of health. These institutions are supported by the funds of the commune or district; in some cases supplemented by the state.

In the United States, with few exceptions, the establishment and maintenance of E. S. are directed by the public school officers of the co., city, town, or village. The state school laws of Mass. provide that towns having free public schools may keep them open day or evening, and that every town and city having 10,000 or more inhabitants must maintain E. S. in addition to their regular day-schools. It is provided in O. that in any district composed in whole or in part of a city or village the board of education or school trustees may establish a suitable number of E. S. Elsewhere, and particularly in large or distinctly manufacturing cities and towns, local educational authorities establish E. S. during the winter months, in which either a general or a technical curriculum is followed, for the benefit of persons, old or young, who cannot avail themselves of the regular facilities during the hours of labor. The first E. S. were established by private benevolence, and many noted ones are still so sustained. The Cooper Union (q.v.) for the Advancement of Science and Art in New York, with its free night schools of phonography, typewriting, and telegraphy; its school of science with 14 classes in technical branches; and its school of art with 9 classes, is of this character. E. S. in general are in the immediate charge of as many principals of the day schools as are required, and while some ambitious day-school teachers also take E. S. classes, it is far more common to select subordinate teachers for E. S. from the list of approved candidates for classes in the day schools and the pupils of the co. or city normal schools. The popularity of E. S. is increasing rapidly in the thickly settled portions of the country, and their statistics must soon form an interesting feature of public educational reports.

EVENT, n. *ě-věnt'* [L. *eventus*, come to pass, happened —from *e*, out of; *věniō*, I come]: that which happens or comes to pass; any incident, good or bad; the conclusion; the result. **EVENT'FUL**, a. *fūl*, producing great changes; full of events. **EVENT'UAL**, a. *-ū-āl* [F. *éventuel*]: happening as a consequence; coming as a result; final; contingent. **EVENT'UAL'ITY**, n. *-āl'ī-tī*, the coming or happening as a consequence; contingency; dependence upon an uncertain event; an organ in phrenology, said to enable one to note and compare all the active occurrences of life. **EVENT'UALLY**, ad. *-lī*. **EVENTUATE**, v. *ě-věnt'ū-āt*, to come out as

EVENTRATION—EVERETT.

a result; to come to an end. **EVENTUATING**, imp. **EVENTUATED**, pp.—SYN. of ‘event’: circumstance; incident; adventure; issue: occurrence; termination; consequence; end.

EVENTRATION, n. *ē-vēn-trā'shūn* [F. *eventrer*—from L. *e*, out; *venter*, the belly]: in *surg.*, a tumor produced by the relaxation of the abdominal wall and ultimately affecting a great part of the abdominal viscera; also a large wound in the abdomen through which the intestines protrude.

EVER, ad. *ēv'ēr* [AS. *œfre*, ever; Goth. *aīs*, long time; Dut. *eeuw*; L. *œvum*; Gr. *aiōn*, an age]: at any time; always; in any degree; contr. into **E'ER**, *är*. **EVER AND ANON**, frequently repeated. **EVER SO LONG**, a very great time. **FOR EVER**, unendingly. **FOR EVER AND EVER**, duration without end. **EVERLAST'ING**, a. *-lăst'ing*, lasting for ever; perpetual: N. never-ending duration; the Deity without beginning or end. **EV'ERLAST'INGLY**, ad. *-li*. **EVERLAST'INGNESS**, n. **EV'ERGREEN**, n. a plant or tree that retains its greenness throughout the year. **EV'ERMORE'**, ad. *-mōr'*, unendingly; always. **EVERLASTING FLOWERS**, flowers which when plucked and dried retain their color for a long time. **EVER A** or **E'ER A**, in *OE.*, any. *Note*.—**EVER**, as part of a word, denotes without intermission. **EVERLASTING**, that which has no end. **ETERNAL**, that which has neither end nor beginning.—SYN. of ‘everlasting, a.’: endless; interminable; unceasing; continual; uninterrupted; incessant; unintermittent; immortal; eternal; infinite; for ever.

EVEREST, *ēv'ēr-ēst*, **MOUNT**: highest known point on the earth: peak of the e. range of the Himalaya Mountains in n. Nepaul; n.e. of Khatmando, between the peaks of Dhawalaghiri and Kunchain-Junga; lat. $27^{\circ} 9' 16''$ n., long. $85^{\circ} 58' 8''$ e.; height above sea level as measured 1856 by Waugh, 29,002 feet.

EVERETT, *ēv'ēr-ēt*: city of Middlesex co., Mass., on the Eastern R. R., 3 m. n. of Boston, with which it is connected by a street railroad. It was incorporated a city, 1893; is lighted by gas, receives its supply of water from Mystic waterworks of Boston; has 4 churches, a young ladies’ institute and several pub. schools, baby-carriage, chemical, phosphate and rope factories. Pop. (1870) 2,220; (1880) 4,159; (1885) 5,375; (1900) 24,336.

EVERETT, *ēv'ēr-ēt*, **ALEXANDER HILL**: 1792, Mar. 19—1847, June 28; b. Boston: diplomatist and author. He entered Harvard College 1802, and graduated 1806, though the youngest of the *alumni*, with the highest honors. After practicing as a lawyer, he was appointed U. S. ambassador at the Hague 1818; and went in the same capacity to Spain 1825. Four years afterward, he returned to the United States, and became proprietor and editor of *The North American Review* (1830–35), and was in the legislature of Massachusetts. In the winter of 1840, he resided in Cuba, as a confidential agent of the United States govt. He sailed for China as minister-plenipotentiary 1845, and

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Fascino of John Lazarus Gutierrez, a Spanish physician, published 1653; and the *Tractatus de Fascinatione* of John Christian Frommann, physician of Saxe-Coburg, 1675. In the British Isles, also, the belief in the power of the evil eye is of old date, and is not dead, at least in Ireland and the Highlands of Scotland. In these countries (as elsewhere), it was once a very common superstition that cattle were subject to injury in this way. Witches had the power to a malignant degree; and various charms, such as twining mountain-ash among the hair of the cow's tail, were used to avert or destroy their noxious influence. In the East, the notion was and is prevalent. The Persians have various methods of discovering the special kind of fascination by which a person is afflicted; and Dallaway, in his *Account of Constantinople* (Lond. 1797), affirms that 'nothing can exceed the superstition of the Turks respecting the evil eye of an enemy or infidel. Passages from the Koran are painted on the outside of the houses, globes of glass are suspended from the ceiling, and a part of the superfluous caparison of their horses is designed to attract attention, and divert a sinister influence.' Hobhouse, in his *Travels*, bears equally conclusive testimony to the prevalence of this superstition in the Turkish empire, not among Mohammedans only, but among Christians also; while Lane, in his *Modern Egyptians* (1836), gives an account of the precautions taken by the Egyptians to avoid the influence of evil eye. The American Indians partake of the same belief; and it is not improbable that on profound investigation it would be found that every nation that exists or has existed, with anything like a developed system of superstition, believes or has believed in the reality of this fascination in some form or other.

The universality of this superstition goes far to prove that it has what may be called a *natural origin*; and, indeed, as the *eye* is the most expressive organ of the soul or mind of man, through which are shot forth, as it were into the visible world of the senses, the hidden passions, emotions, and desires of the nature, it is not strange that in the 'times of ignorance,' when men could give no rational or scientific account of almost any physiological phenomena, if connected with psychology, the eye should have been deemed a centre of malignant influence. The eye is, in fact, as potent as superstition dreams: the error lay not in the recognition of its power, but in explaining the mode of its operation. The person who felt himself under the spell of a powerful gaze, was too agitated to calmly consider the cause of his terrors, and attributed to another results for which mainly he himself was responsible. It was really he that gave to the eye of his fellow-creature its baleful influence; and he quailed less before the force of character which it indicated, than before the fearful fancies with which his own timidity had invested it. See FASCINATION BY SERPENTS.

EVINCE, v. *é-vins'* [F. *évincer*—from L. *evincere*, to conquer completely—from *e*, out of; *vincō*, I conquer or vanquish; It. *evincere*—lit., to conquer completely]: to

EVERGREENS

In 1860 he was a candidate for the vice-presidency of the United States on the ticket with John Bell, of Tenn., but failed of election. The latter years of his life were passed in lecturing and literary work, his last public utterance being an oration on *The Relief of Savannah*, in Faneuil Hall, Boston, six days before his death. He delivered his oration on the *Character of Washington* for the benefit of the Mount Vernon fund 122 times, and turned over \$60,000 as the net proceeds; an address on *Charitable Institutions and Charity* for the Boston Provident Assoc. 15 times, netting \$13,500; and one on the *Early Days of Franklin* for several institutions 5 times, netting \$4,000. He published four vols. of *Orations and Addresses* (1836, 50, 59), beside numerous special works. While U. S. minister to England, he received the degree D.C.L., from Oxford, and LL.D., from Cambridge and Dublin Universities, and was elected a member of the French Institute. As an orator he was elaborately finished and elegant in composition and delivery.

EVERGREENS: trees and shrubs which retain their foliage and remain fresh and green through the winter. The leaves are usually thicker and firmer than those of deciduous trees, while the breathing-pores, or *Stomata* (q.v.), are less in number and appear only on the under surface. In some species, as the fir, the leaves are small and narrow; in others, as the rhododendron, they are large and broad. In most species of E. the leaves fall in the spring when new ones are formed, but the change is effected so gradually that the branches are never bare. Nearly all the *Coniferae* are E. Though growing readily in widely differing climates they largely prevail in northern latitudes, where dense forests of pines, firs, and kindred species are common. They are extremely hardy, and resist the destructive action of frost better than the deciduous trees of cold climates. Certain species, as the pine, thrive best on dry ground, and it is claimed by some that they strongly tend to desiccate the soil. It is not probable that this is the case, though there is no doubt that in winter they exhale moisture in somewhat greater degree than deciduous trees.

Some of the most magnificent E. in the world are in the w. part of the United States. The great California tree (*Sequoia gigantea*) reaches a diameter of 20 to 35 ft., and a height of nearly 300 ft. E. of moderate size are found in vast numbers in the wooded portions of the country, and some of the species, as the pine, spruce, and cedar, are among the finest timber trees. E. are also planted largely for ornamental purposes. Among the best varieties are the Norway Spruce, Scotch Pine, Austrian Black Pine, White Pine, Hemlock, Red Cedar, and Arbor Vitæ. E. should be planted when the first bright new leaves appear (in the Northern States in May or June), because then the sap is thin and less likely to thicken fatally into gum in the process of transplanting. Care is needed to keep the roots from drying in that process, which must be followed by mulching. Sometimes, but rarely, E. succeed on prairies as screens for

EVERICULUM—EVERSLEY.

orchards. For this purpose the Norway Spruce, Hemlock, and Fir have proved of great value. If only a single row of trees is put out, they should be planted not more than eight ft apart. A double row, with the trees 16 ft. apart, though requiring more land, will be much more efficient. E. are used to quite an extent also for fencing purposes, but are gradually losing popularity for this use. The Arbor Vitæ is quite hardy, thrives in a great variety of soils and climates, and forms a beautiful and useful hedge. At the holiday season small E. are in great demand for Christmas trees, and branches are freely used in the interior decoration of public and private buildings.

EVERICULUM, n. ē-vér-rik'ū-lūm [L. a drag-net; *everro*, I sweep out]: in *surg.*, an instrument somewhat resembling a spoon, designed to clear the bladder from fragments of calculi, after the operation of lithotomy.

EVERLASTING FLOWER: popular name of certain plants, the flowers of which suffer little change of appearance in drying, and may be kept for years without much diminution of beauty. They are of the order *Compositæ*, having their flowers (heads of flowers) surrounded with an involucrum; the scales of which resemble the petals of a corolla, but are rigid, membranous, and contain little moisture. Some species of cudweed (q.v.) (*Gnaphalium*) are often called E. F., and the other plants which bear the name belong to nearly allied genera, but particularly to the genus *Helichrysum*, which contains a great number of species, natives mostly of Africa. *H. arenarium* is frequent on dry sandy soils in many parts of Europe and central latitudes of Asia. It is covered with a gray felted down, and has yellow flowers, which, when rubbed, emit a faint aromatic odor. *H. angustifolium* and *H. Stachas*—shrubby species, natives of the s. of Europe—have larger yellow flowers. Some species have a powerful and pleasant aromatic odor. In France these flowers are called *Immortelles*, and often woven into circular wreaths, and placed beside recent graves, as emblems of immortality.

EVERNIA, n. ē-vér'nī-a [Gr. *euernēs*, sprouting, flourishing; *eu*, well; *ernos*, a young sprout, shoot, or scion]: in *bot.*, a genus of lichens, order *Parmeliaceæ*. *Evernia prunastri* is common on trees, but does not often produce fruit. It is said to be an astringent and a febrifuge. It can also be used for dyeing. Formerly it was ground down with starch to make hair-powder, and it has been used as a substitute for gum in calico printing. **EVERNIC**, a. ē-vér'nīk, belonging to or in any way connected with the genus *Evernia*.

EVERSION, n. ē-vér'shūn [F. *éversion*—from L. *ēversōnem*, a turning out or expulsion—from *e*, out; *versus*, turned]: the protrusion of organs from a cavity; the state of being turned back or outward.

EVERSLEY, ēv'érz-lī, **VISCOUNT** (CHARLES SHAW LEFEVRE): 1794, Feb. 27—1888, Dec. 28: parliamentarian, descended maternally from the Lefevres, who came to England from Rouen on the revocation of the Edict of

EVERT—EVIDENCE.

Nantes. He was educated at Winchester and Trinity College, Cambridge, called to the bar at Lincoln's Inn 1819, entered parliament 1830 as member for Downton, and represented Hants 1831–57. In 1839 he was chosen speaker of the house of commons; and re-elected in the parliaments of 1841, 47, and 52. He retired from the office 1857, with a peerage and a pension of £4,000 a year. During the 18 years of his speakership, he suggested and carried out many improvements in the forms and procedure of the lower house, tending to the dispatch of business. He was dignified in person, affable and accessible to the younger members, and profoundly versed in the laws of debate and parliamentary practice.

EVERT, v. *ē-vērt'* [L. *e*; *verto*, I turn]: to destroy; to overthrow; in *med.* and *bot.*, to turn outward.

EVERY, a. *ēv'ēr-ī* [AS. *æfre*, ever; *ælc*, each: OE. *ever-ælc*, every]: the whole, taken one at a time; each one of a whole. **EV'ERYDAY**, a. common; usual. **EVERYTHING**, n. all without exception. **EV'ERYWHERE**, ad. *-hwēr* [ever, and AS. *gehwær*, on every side]: in all places. **EVERY NOW AND THEN**, at short intervals; frequently.

EVESDROPPER, n. *ēvz'drōp'pér* [AS. *efese*]: see **EAVESDROPPER**.

EVESHAM, *ēvz'am* or *ēvz'ham*, originally EOVESHAM: municipal borough in the s.e. of Worcestershire, England, on the right bank of the navigable Avon, 15 m. s.e. of Worcester. It has a fine modern bridge, and a belfry which dates from 1533. Public gardens and water-works have recently been added. E. lies in a beautiful and fertile vale, and market-gardening is the chief industry. It has some manufactures of agricultural implements. Simon de Montfort was defeated at E. 1265.—Pop. (1881) 5,112.

EVICT, v. *ē-vikt'* [L. *evictus*, conquered completely—from *e*, out of; *vinco*, I conquer]: to dispossess of lands or tenements by legal proceedings, as a tenant by a landlord; to recover land, etc., by legal process. **EVIC'TING**, imp. **EVIC'TED**, pp. **EVIC'TION**, n. *-vīk'shūn* [F.—L.]: the recovery of lands or tenements from another's possession by legal proceedings, in virtue of a preferable title. Eviction from land alone is sometimes called Ouster. See **BALFOUR**, **ARTHUR JAMES**; **DAVITT**, **MICHAEL**; **GLADSTONE**, **WILLIAM EWART**; **HOME RULE**, in Ireland; **LAND LEAGUE**, **IRISH**; **PARNELL**, **CHARLES STEWART**.

EVIDENCE, n. *ēv'i-dēns* [F. *évidence*—from L. *evīden-tēm*, plain, distinct—from *e*, out of; *vīdēō*, I see—*lit.*, state of being plain and distinct]: a witness; that which enables the mind to see truth; proof; testimony; certainty: V. to prove; to show; to make clear to the mind. **EVIDENCER**, *-sēr*, witness, one who gives evidence. **EV'IDENCING**, imp. **EV'IDENCED**, pp. *-dēnst*. **EV'IDENT**, a. *-dēnt* [F.—L.]: plain; clear; obvious; open to be seen. **EV'IDENTLY**, ad. *-lī*, plainly; notoriously. **EV'IDEN'TIAL**, a. *-dēn'shāl*, clearly proving. **EVIDIBLE**, a. *ēv'i-dī-bl*, capable of bearing evidence.—SYN. of 'evident': manifest; apparent; notorious; visible; conspicuous.

EVIDENCE.

EVIDENCE, in Law: the means by which matters of fact may be proved or disproved. E. may be either oral, i.e., consist of the statements of witnesses given in court, or documentary, i.e., made up of writings of various kinds. The weight to be attached to any particular E. is a question entirely within the province of the jury; but whether such E. is competent or admissible to prove or disprove the issue under consideration, is for the judge to determine.

Since proof amounting to the certainty of demonstration is available only in abstract science, and does not exist in the common relations of mankind, a standard short of demonstration, yet sufficient to convince the mind, must be applied to the settlement of disputes in courts of law. The burden of proving a fact is always upon the party asserting or seeking to maintain the affirmative. Such a fact is sufficiently proved, in a civil case, by a preponderance of E., but in a criminal trial, in order to convict, the jury must be satisfied beyond a reasonable doubt, that the prisoner committed the offense with which he stands charged. Certain things are said to be 'judicially taken notice of' in courts of law, which simply means that their existence is assumed without any proof in the particular case. Instances are—the public acts of sovereign states, the meaning of ordinary words and abbreviations, the well known and commonly observed phenomena of nature, the divisions of time universally recognized, and the like. E. is spoken of as *direct* or as *circumstantial*. Direct E. is that of witnesses deposing of their own personal knowledge to facts, while circumstantial E. is the inference drawn from facts proved. Attempts have been made to throw discredit upon circumstantial E., but properly regulated by the abundant tests and safeguards which the law places around this method of proof, it becomes as effective as direct E. for the discovery of truth. Sometimes it is even more convincing.

Presumptive E., or E. assumed by the court to exist on a given state of facts being proved, is founded upon presumptions of law and presumptions of fact. Presumptions of law are again divisible into conclusive and disputable presumptions. In conclusive presumptions, no E. is permitted to be received to rebut the inference, which the law, for reasons of expediency, says shall be drawn in such cases. In disputable presumptions, however, E. may be received to rebut the influence, which otherwise would be drawn. E., to be legally receivable in a court of justice, must be relevant; that is to say, it must be so connected with the issue in dispute as directly to prove, or have a tendency to prove, that particular issue, and it must be the best E. which can, under the circumstances be procured. Witnesses are permitted to testify only as to such facts as are within their own knowledge. Statements communicated to a witness by a third party, whether spoken or written, are called 'hearsay,' and unless under the circumstances such statements can be shown to be original E., they cannot be received. To this rule, however, there are exceptions, founded upon the difficulty or impossibility of procuring better E. in the excepted cases. The testimony of *inter-*

PLATE 7.

Evergreens
Excavator

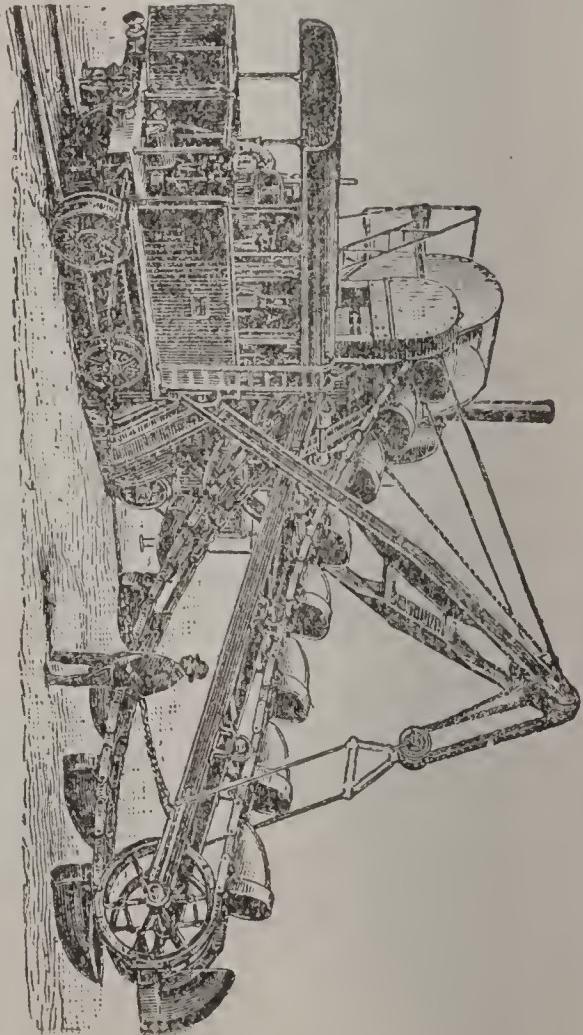


Evergreens.—A, Ardisia; B, Holly (*Ilex*); C, Skimmia.



Everlasting Flower (*Helichrysum bracteatum*).

Steam Excavator.



EVIDENCES OF CHRISTIANITY.

ested witnesses, formerly not admissible, is now received and estimated at its value in view of their interest in the case. Charles J. McCurdy of Conn. secured this change in that state abt. 1848; N. Y. followed; then the other states. In 1851, Mr. McCurdy visited England, and his presentation of the question wrought a change in the law there, also, which has often been incorrectly attributed to Lord Denman. Certain kinds of E. are not received in courts on the ground that the interests of society require them to be excluded. Such are the testimony of husband and wife in certain cases, and professional communications made to a lawyer. Although not so at common law, by statute in many of the American states, confessions to a minister of religion, and information imparted to a physician in the course of professional treatment, cannot be revealed upon the witness stand. This restraint of secrecy is placed also upon the doings of grand jurors, judges, and state officials. The method of procuring the attendance of witnesses, if within the jurisdiction of the court, is by sub-pœna. If beyond the jurisdiction of the court, or within its jurisdiction, but unable to attend personally, the method of procuring the witness' testimony is by commission or deposition respectively. As a rule, a witness in a civil case is entitled to a fee for attending and for his travelling expenses, varying in the different states. In criminal cases, a witness is usually required to attend without fee. The practice in swearing witnesses is to have the witness lay his hand upon and kiss the volume containing the gospels, but a witness may be sworn in any manner obligatory upon his conscience. In some of the American states, a simple affirmation on the part of the witness is deemed sufficient. A witness is not bound to answer where such answer will expose him to a forfeiture of his property, or to a criminal penalty, nor is any inference permitted to be drawn prejudicial to the witness from such refusal to answer. But if the answer merely exposes the witness to a civil action, or pecuniary loss, or has a tendency to degrade his character, he is not excused from answering. The principles applicable to the admissibility and competency of E. are usually the same in civil as in criminal trials. But in criminal trials two very important facts must be proved. These are the *corpus delicti*, and the identity of the prisoner. By the *corpus delicti* is meant the body of the offense. Thus, if a murder or robbery is charged, a murder or robbery must first be proved. A neglect to insist upon a strict adherence to this rule might result in a conviction of a person of murder, while the person supposed to be murdered might still be living. The proof of the identity of the prisoner also is fundamental.—See OATH: JURY: WITNESS: DEED: TESTING: ETC. See also works on E. (American), Greenleaf; (English) Taylor; (Scotch) Dickson.

EVIDENCES OF CHRISTIANITY: see CHRISTIANITY.

EVIL.

EVIL, a. *ē'vl* [Ger. *übel*; Goth. *ubils*; Dut. *evel* and *euvvel*: comp. Gael. *aimh* = *āv*, a prefix denoting negation or deprivation]: ill; wicked; vicious; having bad qualities of any kind; injurious; unfortunate; unkind: N. wickedness; misfortune; calamity; the reverse of good; suffering; that which produces pain; any transgression of the moral law; sin. **E'VILNESS**, n. badness of whatever kind. **EVIL-MINDED**, possessed of bad dispositions. **EVIL-DOER**, a wicked person. **EVIL-EYE**, influence for injury, supposed to be possessed by certain persons who cast an envious or hostile look on any other person or object. **EVIL-EYED**, -*id*, having an evil-eye with the power of fascination. **EVIL-SPEAKING**, slander; calumny. **EVIL ONE**, Satan. **EVILLY**, ad. *ē'vl-i*, in an evil manner. **EVIL-WORKER**, one living in habitual wickedness. **KING'S EVIL**, scrofula—so named from the former popular belief that it was curable by the touch of royalty (see SCROFULA).—SYN. of 'evil, a.': bad; perverse; wrong; calamitous; mischievous; pernicious; hurtful; destructive; corrupt.

EVIL: the opposite or negation of good; popularly, either wickedness or calamity; essentially and morally, that which is opposed to the divine order of the universe. A superficial observation shows many apparent exceptions to the pervading harmony and happiness of creation: there are convulsions in the physical world; there are suffering, decay, and death throughout the whole range of organic existence; and the appellation of evil is commonly applied to such phenomena. In the face of the human consciousness, such phenomena appear to be infractions of the general order and good, and it pronounces them *evil*. How far the internal feeling of wrong has been quickened and educated by such outward facts, it is difficult to say, but, beyond doubt, they have exercised upon it a powerful influence. Every form of religion testifies to the recognition of evil in the external world, and superstition in all its shapes rests mainly upon it.

But it is in the sphere of moral life alone that the conception of evil can be said to hold good. After the light of science has explored the secrets of nature, and shown how its apparent anomalies are merely manifestations of a comprehensive harmony, the idea of evil is dispelled from the merely material creation. 'Whatever is, is best,' is seen to be everywhere the law of this creation. There remains, however, the ineradicable feeling of evil in human life and manners and history. There is in the moral consciousness of man a sense of violated order, of transgression of divine law, or what is called *sin*, which is *evil* in its essential form. This fact of evil is everywhere appealed to by the Christian religion; it is the aim of this religion to deliver men from its power and misery. Every ethical and judicial code is based upon its recognition, and is designed to protect human society from its injurious consequences. It cannot be better or more clearly defined than as a lack of conformity to, or as a transgression of the divine law.

The question of the *origin of evil* has been greatly discussed, and received various answers. The simplest and

EVIL.

most direct of these answers is that which maintains a double origin of things, or a system of *dualism*. This conception lies at the bases of many forms of religion; it may be said to be the fundamental conception of all mere nature-religions. Interpreting the obvious appearances of nature, they embody in divine personalities its contending manifestations of light and darkness, benignity and terror. The opposition of Ormuzd and Ahriman in the old Zoroastrian faith is one of the most conspicuous examples of this religious dualism. Manicheism, which spread so widely in the 4th and 5th c., and the Syrian gnosticism from which it sprang, also are historical illustrations of the same principle.

The dualistic theory of the origin of evil, however, could not obviously maintain itself with the advance of speculation and the spread of Christian truth. It was no less clearly a postulate of the cultivated reason than a dictate of divine revelation, that the world proceeded from and is upheld by One absolutely Divine Creator, holy and good, of whom, and through whom, and to whom are all things. It was necessary, therefore to reconcile the appearance of evil with this fundamental admission.

The doctrine of the Fall, especially in the later development which connects it with the existence of a devil or evil spirit, tempting man in the shape of the serpent, was supposed to explain the appearance of evil in human history. Being tempted of the devil, man sinned, and so fell from his obedience to the divine law. This has been known as the orthodox Christian answer to the inquiry, how sin came into the world? And many minds, seeking only the origin of sin in human history, carry the inquiry no further. It is clear, however, that this explanation of the historical origin of evil leaves the question of its ultimate and absolute origin unsettled. The devil being assumed as the cause of man's sin, the further question arises, whence the devil? Is he an absolute personality? in which case we are landed in the old theory of dualism; or is he, according to the traditional Christian conception, a fallen angel? in which case the former question returns, whence the spring of evil in him? There is no real explanation gained by this removal of the question; it is still the same difficulty—whence the origin of evil in the creation of an all-perfect being, almighty as well as all-wise and good?

Speculation may please itself with ingenious and sometimes instructive answers to this question, but in truth it admits of no satisfactory solution by man's present faculties and with his present knowledge. Some, for example, have argued that evil, like darkness or cold, is an indispensable element of alternation or contrast in human life. All individual reality is only the product of opposite forces working together. Character could arise only from the interaction of opposing ethical influences of good and evil. In nature, we have attraction and repulsion, rest and motion, positive and negative electricity; why should it be different in the sphere of morals? Here, too, there must be polarity. Good can exist only in contradistinction to evil; the one no

EVIL EYE.

less than the other is necessary to constitute the drama of human life and history. Others, again, have argued, that evil is the result of what is called metaphysical imperfection. God alone can be perfectly good. The creature, in its very nature, is limited, defective; and evil is nothing else than the evidence of this limitation in man. It is not something real or positive, but only a privation. It is in morals what cold and darkness are in physics, a pure negation. Thus have argued such profound thinkers as Augustine and Leibnitz. But it requires little penetration to see that such arguments, however ingenious, and so far well founded, do not meet the essential difficulty of the problem. If evil be, according to such views, a necessary element of human life, in the one case, in order to develop its activity, in the other case, as clinging to its creaturely limitations, then plainly it is not, as regards the whole scheme, *evil*, but is essentially so only in and as concerns the individual who develops it: it is not, and cannot be a contradiction of the true idea of human life, and at the same time a necessary element of it. Whatever necessarily belongs to life, must help its true development, and not injure and destroy it; must be *good*, in short, and not *evil*. Such theories, therefore, solve the problem only by eliminating the fact. The origin of evil must be deemed inscrutable, as being dependent on the free moral agency of personal beings. It is in its ultimate sense conceivable only as a possible quality of free moral action; and moral freedom in man or any created being is one of those ultimate facts which are a profound mystery. It is something which 'we apprehend, but which we can neither comprehend nor communicate.' Evil, in its essential (i.e., moral) sense can be overcome: *good* is more ancient and more strong.

E VIL EYE: supposed power of inflicting injury by a look. Both in ancient and modern times, the belief that some persons have the power of injuring others by looking upon them, has been widely diffused. The Greeks frequently speak of the *Ophthalmos Baskanos* (evil eye), which they conceived specially dangerous to children; and the Romans used the verb *fascinare* to express the same fact. Pliny speaks—not on his own authority, however—of 'those among the Triballians and Illyrians, who with their very eyesight can witch (*effascinent*), yea, and kill those whom they look wistly upon any long time;' and Plutarch states, on the authority of Philaretus, that 'the Thybiens who inhabited Pontus were deadly, not only to babes, but to men grown, and that whomsoever their eye, speech, or breath would reach, were sure to fall sick, and pine away.' Menalcas, in Virgil (*Ecl.* iii. 102), also complains that some evil eye has fascinated his young lambs—

Nescio quis teneros oculus mihi fascinat agnos.

The principal amulet used by the ancients was the *phallus* or *fascinum*, as the Romans called it, which was hung round the neck of children. Of course, this superstition, like all others, flourished in Europe during the middle ages. See Reginald Scot's *Discovery of Witchcraft*; the *Opusculum de*

EVERETT.

died at Canton. E. was a man of great versatility of talent and of extensive erudition. Politics and belles-lettres, political economy and poetry, statistics and aesthetics, alternately engaged his thoughts and pen. His writings are —*Europe, or a General Survey of the Political Situation of the Principal Powers*, etc. (London and Boston, 1822); *New Ideas on Population*, etc. (London and Boston, 1822); *America, or a General Survey of the Political Situation of the Several Powers of the Western Continent*, etc. (Phila. 1827), in which he labors to show that Russia and the United States must in the long-run share the continent between them; *Critical and Miscellaneous Essays* (two series, Boston 1845 and 47). These are on a vast variety of subjects, and are probably the most interesting productions of his pen. E. published a vol. of poems 1845.

EVERETT, EDWARD, LL.D., D.C.L.: 1794, Apr. 11—1865, Jan. 15; b. Boston: orator and statesman. He studied in the public schools, where he twice won the Franklin medal, and at Exeter Acad., graduated at Harvard Univ. with high honors when a little more than 17 years old (1811), was appointed tutor of Latin at Harvard, studied theology, and was ordained pastor of the Brattle Street (Unit.) Church, Boston, 1814, Feb. 9. In 1815, Mar., he was chosen Eliot prof. of Greek literature at Harvard Univ., and, resigning his pastorate, went to Europe, studied at the Univ. of Göttingen two years, and spent two years in travel and special study in Greece. Returning 1819, he entered upon his duties as prof., and held the chair till 1825. He delivered a sermon in the hall of the house of representatives, Washington, 1820, which was pronounced a masterpiece of pulpit eloquence; an oration (*Phi Beta Kappa*) at Cambridge before a distinguished audience, that included Gen. Lafayette, 1824, Aug.; and one on Forefathers' Day at Plymouth in Dec. following. In 1824 he was elected member of congress from the Middlesex dist.; resigned his professorship the following year; served in congress by re-elections till 1835, when he was elected gov. of Mass.; was re-elected three times, and defeated the fourth year by one vote out of over 100,000. In 1840 he established himself in Florence, Italy, for the purpose of writing history, but within a few months was summoned to London to enter upon the duties of U. S. minister, to which he had been appointed through the influence of Daniel Webster and without his own knowledge. After four years of diplomatic service in England, he returned to the United States, again promising himself a period of leisure to undertake his projected historical work, and again meeting disappointment, as he was immediately elected to the vacant presidency of Harvard Univ., which office he held 1846–49. He then sought retirement in his own choice library in Boston, where he was undisturbed by calls to public duty till 1852, Nov., when upon the death of Daniel Webster, then U. S. sec. of state, he was appointed by Pres. Fillmore to the vacant office. He served to the close of that administration, was then elected U. S. senator by the Mass. legislature to succeed John Davis, resigning after one year because of ill health.

EVISCERATE—EVOLUTE AND INVOLUTE.

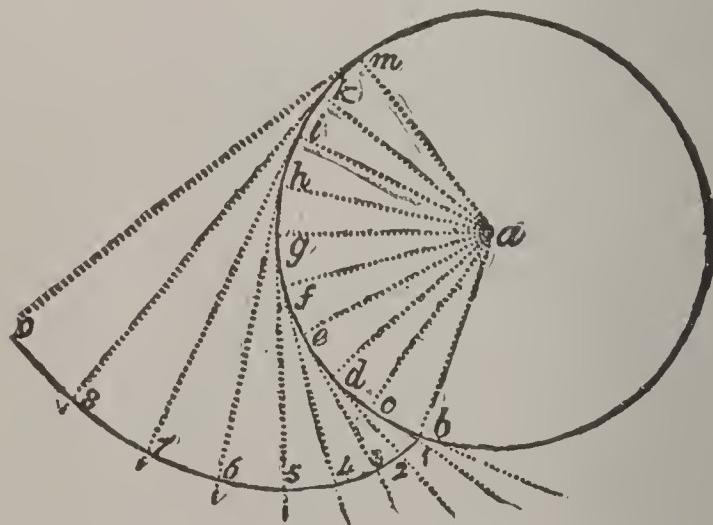
make evident; to prove beyond doubt; to show in a clear manner. **EVIN' CING**, imp. **EVINCED'**, pp. *-vīns't'*. **EVIN'-CIBLE**, a. *-sī-bl*, capable of proof; demonstrable. **EVIN'-CIBLY**, ad. *-bli*. **EVINCE'MENT**, n. act of evincing. **EVIN'-CIVE**, a. *-sīv*, tending to prove.

EVISCIERATE, v. *ē-vīs'sér-āt* [L. *eviscerātus*, disemboweled—from *e*, out of; *viscērū*, the bowels]: to take out the bowels or entrails of; to disembowel. **EVIS'CER-ATING**, imp. **EVIS'CERATED**, pp. **EVIS'CERA'TION**, n. *-āshūn*.

EVITATE, v. *ē-vī-tāt* [L. *evitātus*, avoided—from *e*, out; *vītō*, I shun]: in *OE.*, to shun; to avoid; to escape. **EV'ITATING**, imp. **EV'ITATED**, pp. *-tā-tēd*. **EV'ITA'TION**, n. *-tāshūn*, act of avoiding.

EVOKE, v. *ē-vōk'* [F. *évoquer*—from L. *evōcārē*, to draw forth—from *e*; *vōcō*, I call]: to call forth. **EVO'KING**, imp. **EVOKE'D**, pp. *-vōkt'*. **EVOCATE**, v. *-kāt*, to call out or forth. **EVOCATION**, n. *ē'ō-kāshūn* [F.—L]: the act of calling out.

EV'OLUTE AND IN'VOLUTE: *Evolute* of any curve, the locus of the centre of its osculating circle: *Involute*, the curve relative to its evolute. This is the simplest definition of an evolute and involute, which are relative terms. There is another, however, which may represent the relation of the curves more clearly to those not mathematicians. If on any curve a string be closely wrapped, and if the string be fastened at one of its ends, and free at the other; and then if we unwind the string from the curve, keeping it constantly stretched, the curve which would be traced out by a pencil fixed to the free end of the string, is called the involute of that from which the string is unwound, and relative to it, the latter is called the evolute. It is clear that



the involute might otherwise be described by fastening a string at one extremity of the evolute, and wrapping it thereupon, keeping it always stretched. From either definition, it is clear that a normal to the involute at any point is a tangent to the evolute, and that the difference in length between any two radii of curvature to the involute is equal to the length of the arc of the evolute intercepted between

EVOLUTION—EVOLVE.

them. See CURVATURE: OSCULATING CIRCLE. The nature of evolutes was considered first by Huyghens, who showed that the evolute to a common cycloid is another equal cycloid, a property of that curve which he employed in making a pendulum vibrate in a cycloid. To describe the involute of a circle, proceed as follows: Let *a* be the centre of the circle, and *b* the extremity of the string to be unwound from its circumference. Divide the circle, or part of the circle, according to the length of curve required, into any number of equal parts, as *c*, *d*, *e*, etc.; through these, from *a*, draw radial lines; from the points where these touch the circle, draw, at right angles to the lines *ac*, *ad*, etc., other lines, as in the diagram. With the distance *cb* as radius from the point *c*, describe an arc *b1*, cutting the line *c1* in 1. From the point *d*, with *d1*, describe an arc 1 2, cutting the line *d2* in 2. From *e*, with *e2*, describe an arc 2 3, cutting the line *e3* in 3. With radius *f3*, from *f*, describe an arc 3 4, cutting *f4* in the point 4. Proceed in this way, describing arcs which pass through the points 5, 6, 7, 8, and 9. The involute will thus be formed.

EVOLUTION: see under EVOLVE.

EVOLU'TION AND INVOLU'TION: algebraical terms, the former signifying *the extraction of roots*, and the latter *the raising to powers*. When any number is multiplied by itself, the product is called its square, or second power. If we multiply the square by the number again, we get the cube, or third power; and so on: this process is called involution. Evolution is the inverse process, by which a number being presented, we may ascertain a particular root of it, say the fourth; or that number which, being multiplied into unity a particular number of times, say four times, the product will be the number presented: see EXTRACTION OF ROOT.

EVOLVE, v. ē-vōlv' [L. ēvolvērē, to roll out or forth—from *e*, out of; *volvo*, I roll]: to open and expand; to disentangle; to develop. EVOL'VING, imp. EVOLVED', pp. -vōlvd'. EVOLVENT, n. -ēnt, in geom., the involute of a curve. EVOLVER, n. -ēr, one who or that which evolves. EVOLUTION, n. ēv'ō-lō'shūn [F.—L.]: the act of unfolding or unrolling; a series of things unfolded arising the one from the other; the gradual descent or development of forms of life from other pre-existing ones; the extraction of roots in arithmetic or algebra, thus, $\sqrt[3]{125}$ or $125^{\frac{1}{3}} = 5$, indicates that the number or root is to be found which, multiplied 3 times by itself, will produce 125—the opposite of *involution*, which see: in milit., movement in order to a change in the arrangement and disposition of a body of soldiers in the field or at a review. All such movements as marching, counter-marching, route-marching, changing front, forming line, facing, wheeling, making column or line, making échelon or square, defiling, deploying, etc., come under the general heading of evolutions: see TACTICS, MILITARY AND NAVAL. Other things being equal, the best evolutions are those which occupy least time and least space. The word evolution applies equally to the movement of ships in

EVOLVULUS—EVORA.

a fleet. **EVOLUTION THEORY**, theory which maintains that the first created animals contained the germs of all future possible successors, successively included one within the other, and that generation is merely the act of unfolding the germ; the theory that every existing form of animal or plant life, even man himself, has been gradually produced or *evolved* during countless ages from one or two monads, or animalcules; the theory that each species of animal is not a special creation, but is gradually produced by the modification of others: see **DESCENT OF MAN: DARWINIAN THEORY: SPENCER, HERBERT: CREATIONISM: SPECIES.**—**EV'OLU'TIONAL**, a. -lō'shūn-äl, connected with evolution. **EV'OLU'TIONARY**, a. -ér-i, pertaining to evolution. **EV'OLU'TIONISM**, n. -izm, theory or doctrine of evolution. The term was introduced by Prof. Huxley in his presidential address to the Geological Society 1869. With it he introduced the terms **Catastrophism** and **Uniformitarianism**, the three words being designed to discriminate the three chief schools of geological thought. **EVOLUTIONIST**, n. -ist, one holding the doctrine of evolution, as distinguished from that of uniformity and that of successive catastrophes.

EVOLVULUS, n. ē-vō'l vū-lūs [L. *evollo*, I roll out; not twining, as opposed to *Convolvulus*, which twines]: a genus of *Convolvulaceæ*. It has entire, nearly sessile leaves, and small flowers. About 60 species are known, chiefly from tropical America.

EVORA, ēv'o-rā (ancient *Ebora*): city of Portugal, cap. of the province of Alemtejo, and, after Coimbra, and perhaps Thomar, the most interesting city in the country; beautifully situated on a fertile and elevated plain, 48 m. w.s.w of Badajoz, about 80 m. e. of Lisbon. It was formerly a place of considerable strength; but its ramparts, and the towers which flanked them, its citadel, its forts, and its watch-towers, are now in hopeless ruin. The town itself is not well built, its streets are narrow and winding, and its houses old and badly planned. It has a cathedral, a large Gothic edifice, founded 1186, the choir of which, rebuilt 1721, is in the Italian style, and is richly adorned with marbles of various colors. E. has been the see of an archbishop since 1541; has an archiepiscopal library containing more than 50,000 vols.; and several pictures of great merit, attributed to Gran Vasco. It has manufactures of ironware and leather, and a well-attended annual fair. Pop. about 12,000.

E. is a very ancient city. Quintus Sertorius took it B.C. 30. It was conquered also by the Moors A.D. 712, but retaken from them 1166. The Roman antiquities of E. are unrivalled in the Peninsula. Among these, the temple of Diana, used as a slaughter-house for some time previous to 1834, exhibits in its fine Corinthian columns admirable proportion and delicacy of sculpture. There is also an aqueduct, 1,200 paces in length, erected by Quintus Sertorius; but the most beautiful Roman relic, and one of the most perfect pieces of ancient architecture extant, is the tower which rises in the city at the extremity of the aque-

EVOSMIA—EVREUX.

duct. It is 12 ft. 6 inches in diameter, and is surrounded by eight columns of the Ionic order. Ionic pilasters decorate the second story, and the top is crowned with a hemispherical dome. It is wholly of brick, and covered with cement of such a durable nature, that, though this delicate structure has stood since B.C. 70, few parts of it seem impaired by time.

EVOSMIA, n. ē-vō'smī-a [Latinized form of Gr. *euosmos*, sweet-smelling, fragrant; *eu*, well, good: *osmē*, smell]: genus of cinchonads, tribe *Cinchoneæ*, family *Hamelide*. It has red flowers and sweet-smelling berries. *Erosmia corymbosa* is poisonous.

EVOVÆ, n. ē-vō'vā-ē: in *mus.*, artificial word, consisting of the vowels in *Seculorum Amen*, at the end of the *Gloria Patri*. It was designed to serve as a mnemonic word to enable singers to render the several Gregorian chants properly; each letter in Eovæ standing for the syllable whence it was extracted. The author of the article in Smith's *Christian Antiquities* says that the Eovæ must be regarded as containing the germ of the present accepted views respecting musical accent. A modern imitation of the word was proposed by Mr. Dyce, but never came into use. It remains a mere curiosity, inasmuch as more obvious means exist of expressing accent.

EVREMOND, āvr-mōng', CHARLES MARGOTELLE DE ST. DENIS, Seigneur de St.: 1613, Apr. 1—1703, Sep.; b. at St. Denis-le-Guast, Normandy: author and wit. He entered the army about the age of 15, became an ensign in less than a year, and 1637 had the command of a company of foot. About this time, he gained the favor and friendship of Turenne, Grammont, the Prince of Condé, and others of high rank, all of whom were delighted with his wit and cheerfulness. Having talked himself into the esteem of these men, it was not long until, by the same means, he brought himself under their displeasure. In 1661 his unbridled indulgence in raillery compelled him to take refuge in England. Many attempts were made at the French court to induce Louis XIV. to recall St. E., whose accomplishments, gayety, and wit rendered him the delight of all who had not smarted from his sarcasm; but Louis remained immovable until 1689, when he granted the exile permission to return. It was now, however, too late. St. E. had by this time surrounded himself with an admiring circle of the wits and beauties of the English court, and resolved to remain where he was. He died in his 91st year. St. E.'s works, comprising comedies, classical essays, etc., were correctly published first by Des Maizeaux, with a life of the author (Lond. 1704): they are translated into English by the same editor.

EVREUX, ēv-rūh' (anciently *Mediolanum*, and more recently *Eburorices*): episcopal city of France, dept. of Eure, of which it is cap.; pleasantly situated in a valley on the Iton, a feeder of the Eure, 60 m. w.n.w. of Paris. It is well built, its streets regular, and the environs prettily laid out in promenades, gardens, and vineyards. The principal

EVULATION—EWALD.

building of E. is the cathedral, which dates from the 11th c. Other buildings of note are the abbey church of St. Thaurin, originally built over the tomb of St. Thaurin, first bishop of E., and having a shrine executed in the 13th c., which formerly contained his relics; the Bishop's Palace, built 1484; and the *Tour de l'Horloge* of the same century. E. has extensive manufactures of bed-ticking, woolen stuffs, cotton-yarn, leather, vinegar, and a trade in its manufactures, and in grain, seeds, timber, and liqueurs.—E. is remarkable for the numerous sieges which it has sustained. It was taken by Clovis from the Romans; was sacked and plundered 892 by the Northmen, under Rollo; was burned by Henry I. of England 1119; and twice captured (1194 and 99) by Philippe Auguste, King of France, into whose hands, after a short time, it permanently came. It was frequently taken and recovered in the wars between France and England during the reigns of Henry V. and Henry VI. of the latter country.—Pop. 12,000.

VIEIL EVREUX (*Old Evreux*), village near E., supposed site of the anc. Mediolanum, has some ancient remains of a theatre, an aqueduct, and fortifications.

EVULGATION, n. ē-vūl-gā'shūn [L. *evulgatus*, pp. of *evulgo*, I make common or public]: act of publishing, making known, or divulging.

EVULSION, n. ē-vūl'shūn [L. *evulsiōnem*, a pulling out—from *e*, out of; *vulsus*, plucked]: the act of plucking out.

EWALD, ā'vālt, GEORG HEINRICH AUGUST VON: 1803, Nov. 16—1875, May; b. Göttingen; distinguished orientalist. He showed predilection for Oriental literature even in his school-days. He studied at the univ. of his native place, and while a student wrote *Die Composition der Genesis* (Braunschw. 1823). In 1823, he became a teacher at the Wolfenbüttel gymnasium; in 1827, extraordinary, and in 1831, ordinary, prof. of philosophy at Göttingen; in 1835, was appointed nominal prof. of the Oriental languages. Travels in search of Oriental MSS. led him, in 1826, 29, and 36, to Berlin, Paris and Italy. After the death of Eichhorn, the critical exegesis of the Old Testament was included in his duties as prof. The first, and perhaps the most important fruit of his new labors, was his Critical Grammar of the Hebrew Language (*Kritische Grammatik der Hebr. Sprache*, Leip. 1827), an abridgment of which was published Leipsic 1835 (*Grammatik der Hebr. Sprache*; 5th edit. 1844); and a still simpler epitome 1842 (*Hebr. Sprachlehre für Anfänger*). Before this, however, E. had acquired high reputation by his work on Canticles (*Hohe Lied Salomo's*, Gött. 1826); his Commentary on the Apocalypse (*Commentarius in Apocalypsin*, Leip. 1828); his Poetical Books of the Old Testament, 4 vols. (*Die Poetischen Bücher des Alten Bundes*, Gött. 1835–37); and his Prophets of the Old Testament, 2 vols. (*Die Propheten des Alten Bundes*, 2 Bde., Stutt. 1840). Between 1843–50, E. published an important work in 4 vols., on the History of the People of Israel until the Time of Christ (*Geschichte des Volkes Is.*

rael bis auf Christus; Eng. trans. 1869-74), and a subsidiary vol. on the Antiquities of the People of Israel (*Die Alterthümer des Volkes Israel*). The *Geschichte des Volkes Israel*, together with its two continuations, The History of Christ and his Time (*Geschichte Christus und seiner Zeit*, 1857), and The History of the Apostolic Age, etc. (*Geschichte des Apostolischen Zeitalters bis zur Zerstörung Jerusalems*, 1858), is regarded as E.'s greatest work. But Jewish history and literature did not limit the sphere of E.'s wonderful activity. His lectures at Göttingen embraced the literature of the Arabic, Persian, Aramaic, and Sanskrit tongues, and gave birth to such works as that on the Metres of the Arabian Songs (*De Metris Carminum Arabicorum*, Leip. 1825); on Some of the Older Sanskrit Metres (*Ueber einige ältere Sanscrit-Metra*, Gött. 1827), an epitome of the Arabic author Wakidi's work on Mesopotamia (*De Mesopotamiae expugnatae Historia*, Gött. 1827), and a Grammar of Arabic, entitled *Grammatica Critica Linguae Arabicæ cum brevi Metrorum Doctrina*, 2 Bde. (Leip. 1831-33). In 1832, E. published at Göttingen several very important Dissertations on Oriental and Biblical Literature (*Abhandlungen zur orient. und biblischen Literatur*), and planned the well-known periodical, Journal for the Knowledge of the East (*Zeitschrift für die Kunde des Morgenlands*). E. was not only a scholar and philologist, but a man of strong political convictions. Having, with six of his colleagues (the brothers Grimm, Dahlmann, Gervinus, Weber, and Albrecht), protested against the abolition of constitutional law and liberty in Hanover by the new sovereign, Ernest Augustus (previously Duke of Cumberland), he was dismissed from his situation, 1837, Dec. 12, and went to England to investigate its public libraries, whence he was called to Tübingen 1838, as prof. of theology. Here he remained ten years. In 1841, he was ennobled by the king of Würtemberg. In 1848, E. returned to Göttingen, where he established a Year-book of Biblical Science (*Jahrbuch der biblischen Wissenschaft*), in which, as well as in his work on the Synoptic Gospels (*Die drei ersten Evangelien*, Gött. 1850), and works on the Epistles of Paul (*Die Sendschreiben des Apostels Paulus übersetzt und erklärt*, Gött. 1857), he strove to give a firmer basis to New Testament criticism and exegesis. E. also gave great attention to Ethiopic literature, a result of which is his valuable Dissertation on the Book of Enoch (*Ueber des Äthiopischen Buches Henoch Entstehung*, etc., Gött. 1856). Later works were *Das Sendschreiben an die Hebräer und Jacob's Rundschreiben* (1871); and *Sieben Sendschreiben des Neuen Bundes* (1871). The distinguishing peculiarity of E., as theologian and critic, was his love for the concrete forms in which divine truths are revealed in history, and his dislike of the abstractions into which they are refined away by over-speculative theologians. He regarded it as the especial glory of the Jewish people, that they never lost sight of the concrete—as the Persians and Hindus, for example, did, with whom the realities of religion vanished into the most intangible dreams—but kept it ever before them until, in the fullness of

EWALD—EWE-GOWAN.

times, there was born among them Jesus of Nazareth, the Perfect and Only One, in whom humanity reached its spiritual consummation. E. refused to class himself or to be classed with any theological party in Germany. He was equally opposed to the extreme left represented in Tübingen, and to the extreme right represented in the modern Lutheran movement headed by Hengstenberg. When Hanover was in 1866 incorporated with Prussia, E. declined to take the new oath of allegiance, and was accordingly required to retire from the functions of the professoriate. He returned to political life; and as the three times elected representative of the town of Hanover in the Reichstag, persistently opposed the new political conditions.

EWALD, *æ'væld* or *æ'väl*, JOHANNES: 1743, Nov. 18—1781; b. and d. in Copenhagen: lyric poet of Denmark. In his 16th year, when his friends were about to send him to the Univ. of Copenhagen, his impatience of restraint led him to escape to Germany, where he entered as a private soldier in the army of Frederick the Great of Prussia, from which he soon deserted to the Austrians. His bravery having attracted the notice of his superiors, he was offered a commission, which he refused, as it would have obliged him to become a Rom. Cath.; and having induced his friends to purchase his discharge, he returned to Copenhagen 1760, after having taken part in the great campaigns of 1759–60. He then began the study of theology, but a disappointment in love turned him toward poetry. His funeral ode on the death of Frederick V. of Denmark, 1767, showed original genius, and gave him rank among the best writers of his country. This was followed by numerous tragedies, operas, and songs, remarkable for lyrical beauty. In 1770, appeared the prose tragedy of *Rolf Krage*. Although *Balder's Doed* (1773), which breathes the heroic spirit of the ancient bards of the north, and exhibits the specially national tendency of E.'s genius, is regarded by some critics as his *chef-d'œuvre*, *Fiskerne*, 'The Fishermen' (1780), probably deserves to rank equally high, when considered as a mere lyrical production. His habits of dissipation, and his decided political opinions brought him into difficulties of every kind, while his infirmities of temper, and irregularities of conduct, estranged the affection of his nearest relatives, and in the latter years of his unhappy life he was often indebted to strangers for subsistence. Some of his nautical songs have been raised to the dignity of national odes. He was engaged at his death in compiling an autobiography, and the complete edition of his writings, which appeared 1792. His works have been edited by F. L. Liebenberg (Copen. 1850–55); and a life compiled from unpublished materials, has recently appeared from the pen of F. C. Olsen, of Copenhagen.

EDDEN-DRIFT: see EWIN-DRIFT.

EWE, n. *ū* [AS. *eowu*; Dut. *ouwe*, a female sheep; Gr. *oīs*; L. *ovis*, a sheep]: a female sheep.

EWE-GOWAN, n. *-gow'an*: in bot., the common daisy (*Bellis perennis*).

EWELL--EWING.

EWELL, *yō'ēl*. RICHARD STODDERT: 1817, Feb. 8—1875, Jan. 25; b. Georgetown, D. C.: soldier. He graduated at the U. S. Milit. Acad. 1840, served in the 1st U. S. dragoons at Contreras and Churubusco, Mexico, 1847, Aug.; became capt. 1849, Aug. 4; was in the campaign against the Apache Indians in N. Mex., 1857, June; resigned his commission 1861, and entered the Confederate army as lieut.col. He took part in the engagements and battles at Blackburn's Ford, 1861, July 18; Bull Run, July 21; Warrenton turnpike (where he lost a leg), 1862, Aug. 28; Front Royal, Cross Keys, Port Republic, and Cedar Mountain; and (as lieut.gen. and commander of the 2d corps of Gen. Lee's army after the death of Gen. 'Stonewall' Jackson), Winchester, Gettysburg, the Wilderness, and Spottsylvania Court-house. Subsequently he was relieved from field duty on account of disabilities, given command of the dept. of Richmond, and captured with his entire force by Gen. Sheridan at Sailor's Creek, 1865, Apr. 6. He afterward settled in Springfield, Tenn.

EWER, n. *u'ēr* [F. *aiguière*, a water-vessel—from L. *aqua*; OF. *aigue*, water: OF. *eauier*, a gutter]: the large jug belonging to a wash-hand basin; a water-jug; a pitcher. **EWRY**, n. *ū'rī*, an officer of the royal household who takes care of the table linen, and serves up water in ewers after dinner.

EWIN-DRIFT, n. *ū'in-drift* [etym. doubtful]: snow driven by the wind; a snow-drift.

EWING, *yō'īng*, FINIS: 1773, July 10—1841, July 4; b. Bedford co., Va.: Cumberland Presb. clergyman. He settled near Nashville, Tenn., on the death of his parents; was licensed to preach 1800, and was ordained a Presb. clergyman by the Cumberland Presbytery 1803. The synod of Ky. refused to recognize his ordination, and was sustained by the Presb. gen. assembly; whereupon with two others he organized the Cumberland Presb. Church, 1810. He preached in Todd co., Ky.; Cooper co., Mo., and at Lexington, Mo., till his death; and was author of *Lectures on Divinity*, in which he formulated the tenets of the new denomination.

EWING, THOMAS, LL.D.: 1789, Dec. 28—1871, Oct. 26; b. near West Liberty, Va.: lawyer. He removed with his parents to O. 1792; was taught the early branches by an elder sister, prepared himself for college while working in the Kanawha salt factory, cleared his father's farm from debt with his own earnings, and graduated at O. Univ., Athens, 1815. In the following year he was admitted to the bar and practiced with success till 1831, when he was elected U. S. senator as a whig. On the expiration of his term he resumed practice. In 1841, he was appointed sec. of the U. S. treas., and 1849 sec. of the new dept. of the interior, which he organized. On the appointment of Thomas Corwin as sec. of the treas. 1850, E. was appointed to succeed him in the U. S. senate, served there about a year, and then retired from public life. He resumed practice at Lancaster, O., and became one of the foremost prac-

EWING--EXACUM.

titioners before the U. S. supreme court. E. adopted Gen. William T. Sherman when 9 years old, appointed him to the U. S. Milit. Acad., and gave his daughter to him in marriage 1850.

EWING, THOMAS, Jr.: lawyer and soldier: b. Lancaster, O., 1829, Aug. 7. He was educated at Brown Univ., was private sec. to President Taylor 1849-50, studied law in Cincinnati, and was admitted to the bar, removed to Leavenworth, Kan., 1856, was a member of the constitutional convention 1858, and the first chief-justice of the state 1861-2. In 1862 he recruited the 11th Kan. vols.; was elected its col.; took part in the battles of Fort Wayne, Cane Hill, and Prairie Grove; was commander of the Mo. and Ark. border dist.; held Pilot Knob with 1,000 men against several attacks by Confederates under Gen. Sterling Price 1864, Sep.; was promoted brig.gen. 1863, Mar. 13, and brevetted maj.gen. of vols. 1865. He was a member of congress from O. 1877-81, and the unsuccessful candidate for gov. 1879; and since 1882 has resided and practiced law in New York. He d. 1896, Jan 1.

EWT: see EFT, or NEWT.

EX, prefix, *ěks* or *ěgz* [L. and Gr. *ex*; Gr. *ek*]: out of; out; off; from; without; denoting merely increase of the power of the simple word. Ex assumes the forms E, Ec, Ef, according to the letter commencing the word of which it forms the prefix. Ex prefixed to the name of an office denotes that the person formerly held the office named, or does not now hold it, as *ex-mayor*, *ex-minister*. EX OFFICIO, *ěks őf-fish'i-ō* [L. *ex*, from; *officio*, office]: by virtue of office. EX PARTE, *ěks pár'tē* [L. *ex*, from; *parte*, a part or side]: partial.

EXACERBATE, v. *ěks-ăs'ér-bāt* [L. *exacerbātus*, provoked, irritated—from *ex*, out of; *acer'bus*, bitter, harsh]: to exasperate; to inflame angry passions; to irritate highly. EXAC'ERBATING, imp. EXAC'ERBATED, pp. EXAC'ERBA'TION, n. *-bā'shūn* [F.—L.]: the act of irritating highly; the irritation itself; increase of violence in a disease; also EXAC'ERBES'CENCE, n. *-bēs'ěns*.

EXACT, a. *ěgz-ăkt'* [F. *exact*—from L. *exactus*, demanded, required—from *ex*, out of; *actus*, done, driven]: very correct or regular; accurate; precise; punctual; methodical; particular; careful; nice. EXACT', v. [OF. *exacter*, to extort—from mid. L. *exactūrē*, to exact—*lit.*, to drive out]: to force to pay or yield; to demand or require authoritatively; to extort. EXACT'ING, imp.: ADJ. harsh; severe; unyielding; compelling to pay or give. EXACT'ED, pp. EXAC'TER or EXAC'TOR, n. *-térf*, one who exacts. EXAC'TION, n. *-ăk'-shūn* [F.—L.]: the act of demanding with authority; that which is exacted; extortion. EXACT'NESS, n. *-ăkt'nēs*, accuracy; regularity. EXACT'LY, ad. *-lī*. EXACTITUDE, n. *ěgz-ăk'ti-tūd* [F.—L.]: exactness; accuracy.

EXACUM, n. *ěgs'a-kūm* [L. *ex*, out; *ago*, I drive; because the plant is said to have the power of expelling

EXÆRESIS—EXALBUMINOUS,

poison]: genus of gentians, tribe *Gentianeæ*. The old *Exacum filiforme* is now *Cicendia filiformis*.

EXÆRESIS, n. ēgs-ē'rē-sis [Gr. *exaireō*, I take away, I remove; *ex*, out, away; *haireō*, I take]: in *surg.*, that branch of surgery which relates to the removing of parts of the body.

EXAGGERATE, v. ēgz-āj'ēr-āt [L. *exaggérātus*, increased by heaping up—from *ex*, out of; *agger*, a heap: It. *esagerare*: F. *exagérer*]: to enlarge beyond the truth; to color highly; to tell more than the truth. EXAG'ERATING, imp. EXAG'ERATED, pp. EXAG'ERA'TION, n. -ā'shūn [F.—L.]: telling more than the truth; hyperbolical representation. EXAG'ERATORY, a. -tēr-i, containing exaggeration.

EXALBUMINOSE: same as EXALBUMINOUS.

EXALBUMINOUS, a. ēks'āl-bū'mi-nūs [L. *ex*, out of, and *albumen*]: in *bot.*, applied to a seed which has no distinct albumen, or none but what is contained within the cotyledons themselves.

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